VOLUME 15 NUMBER 3

ARCHIVES OF SURGERY

EDITORIAL BOARD

DEAN LEWIS, Baltimore

EVARTS A. GRAHAM, St. Louis WALLACE I. TERRY, San Francisco

HUGH CABOT, Ann Arbor, Mich. WILLIAM DARRACH, New York

EDWARD STARR JUDD, Rochester, Minn.

SEPTEMBER, 1927

PUBLISHED MONTHLY BY AMERICAN MEDICAL ASSOCIATION, 535 NORTH DEARBORN STREET, CHICAGO, ILLINOIS. ANNUAL SUBSCRIPTION, $8.00

Entered as Second-Class Matter, July 10, 1925, at the Postoffice at Chicago, Illinois, Under the Act of March 3, 1879. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of Oct. 3, 1917, authorized July 29, 1920.

CONTENTS OF PREVIOUS NUMBER

AUGUST, 1927. NUMBER 2

Postoperative Pulmonary Atelectasis. E. A. Mastics, M.D.; F. A. Spittler, M.D., and E. P. McNamee, M.D., Cleveland.

Glossopharyngeal Neuralgia (Tic Douloureux): Its Diagnosis and Treatment. Walter E. Dandy, M.D., Baltimore.

Experimental Observations on the Growth of Long Bones. Gatewood, M.D., and Bernard P. Mullen, M.D., Chicago.

Paraplegia Associated with Congenital Scoliosis: Report of a Case. Kenneth G. McKenzie, M.D., with Comments by Clarence L. Starr, Toronto, Canada.

Fatal Pulmonary Embolism: A Statistical Review. Earl F. Henderson, M.D., Rochester, Minn.

The Realtion of Obesity to Fatal Postoperative Pulmonary Embolism. Albert M. Snell, M.D., Rochester, Minn.

Postoperative Phlebitis: A Clinical Study. George E. Brown, M.D., Rochester, Minn.

Changes in the Blood Following Operation. Edgar V. Allen, M.D., Rochester, Minn.

Plasma Proteins in Cutaneous Burns. Edward C. Davidson, M.D., and C. W. Matthew, Detroit.

The Carotid Venous Plexus as the Path of Infection in Thrombophlebitis of the Cavernous Sinus: Its Relation to Retropharyngeal and Sphenoidal Suppuration. Wells P. Eagleton, M.D., Newark, N. J.

The Status of Enterostomy in the Treatment of Acute Ileus: A Statistical Inquiry. E. T. van Beuren, Jr., M.D., and Beverly C. Smith, M.D., New York.

A Review of Urologic Surgery (Concluded). Albert J. Scholl, M.D., Los Angeles; E. Starr Judd, M.D., Rochester, Minn.; Linwood D. Keyser, M.D., Roanoke, Va.; Gordon S. Foulds, M.D., Toronto; Jean Verbrugge, M.D., Antwerp, Belgium, and Adolph A. Kutzmann, M.D., Los Angeles.

COPYRIGHT, 1927, BY THE AMERICAN MEDICAL ASSOCIATION

ARCHIVES OF SURGERY

VOLUME 15 SEPTEMBER, 1927 NUMBER 3

PERICARDIOTOMY FOR PYOPERICARDIUM

REVIEW OF LITERATURE TO MAY, 1927, AND REPORT OF TEN NEW CASES*

NATHAN WINSLOW, M.D.
AND
ARTHUR M. SHIPLEY, M.D.
BALTIMORE

According to Heyde, the ancients practiced pericardial incision, but in the opinion of Burtenshaw, meagerness of the reports vitiates their acceptance as genuine examples of this operation. It is said that Galen removed the sternum and anterior wall of the pericardium from a soldier in whom a neglected wound of the chest had led to the development of a suppurative pericarditis and by this means obtained a cure. It is definitely known, however, that as early as 1648, Riolanus advised trephinement of the sternum for drainage of the pericardium. In 1818, Skielderup repeated Riolanus' suggestion, but it was not put into practice until 1855, when Malle evacuated a hemopericardium successfully through an opening in the sternum. The first and only instance of draining a pyopericardium by this route that we could locate in the literature is the case reported by Bexman, in 1891, with recovery of his patient. Four of our patients were so treated; two were cured and two died.

Sénac, in 1794, recommended that the opening into the thorax should be made to the left of the sternum, but the operation was not attempted until 1798, when Desault endeavored to incise the pericardium in a case which had been diagnosed as pericarditis with effusion, but the condition proved to be a localized pleurisy situated in front of the pericardium.

The first successful incision of the pericardium was performed by Romero for serous pericarditis in 1819, at which time he reported two successes and one failure following open drainage between the fifth and sixth ribs on the left side.

The xiphocostal route was first described by Larrey in 1829. It was suggested to him by the case of a soldier in whom he had successfully drained a stab wound in this region communicating with the pericardium.

---

* From the Surgical Department of the University of Maryland.

* Reprints will contain tabulated abstracts of 128 cases of pericardiotomy done for suppurative pericarditis.

The same approach was later proposed by Allingham and practiced by himself, Mintz and Rehn. Pendlebury has modified the method to the extent of resecting the sixth and seventh costal cartilages when it is thought necessary. In three cases of our series this method of approach was adopted, with two recoveries and one death. Of all the ways devised for doing pericardiotomy, either the transsternal or the subchondral route appears to be the best; of the two, the latter is preferable, because it affords more space in which to work, insures a better exploration of the pericardial contents and provides drainage from the lower portion of the sac. Both may be performed with perfect satisfaction under local anesthesia.

To Hilsmann, in 1844, however, belongs the credit not only of being the first to perfom pericardiotomy for pyopericardium, but also of being the first to cure a patient of purulent pericarditis by this means. Six years then elapsed before the operation was repeated by von Langenbeck, with an equally satisfactory result. The procedure was not undertaken again until 1879, when Rosenstein drained successfully the pericardial sac of a boy, aged 10, who was suffering with suppurative pericarditis, secondary to pleurisy. It was the report of Rosenstein, in 1881, concerning this case, that established surgical intervention as the proper treatment for purulent pericarditis. Less drastic measures had been thoroughly tried out and found wanting. Drugs had proved utterly worthless. Aspiration, though affording some temporary relief, invariably failed to save the life of the patient. Notwithstanding these examples of cures and the noteworthy statistical studies of Roberts (1897), Porter (1900), Eliot (1909), Rhodes (1915) and Poole (1921), pointing out the advantages of operative measures over therapeutic agents, the medical profession has been loath to advise drainage of the pericardial sac in the presence of pus, as the 118 cases collected from the literature by the authors of this paper bear silent but eloquent testimony. This antipathy toward pericardiotomy is indeed strange and hard to explain when contrasted with the directly opposite attitude adopted toward the management of suppurative peritonitis and empyema, in every way strikingly comparable conditions from the standpoint of therapeusis. The objects of this paper are, first, to add ten hitherto unpublished instances of pericardiotomy for pyopericardium to the literature and, second, to review the subject critically with the idea of bringing the history of surgical treatment of this malady up to date.

REPORTS OF CASES

CASE 1.—A white boy, aged 4, entered the hospital on June 23, 1924. He was critically ill, having been sick a month with tonsillitis, otitis media and arthritis. His pulse was 160 and respiration 62; the face was deeply cyanosed, and his expression was anxious. The physical signs pointed to a pericardial effusion as the cause of the trouble, and the surmise was proved correct by the aspiration of 250 cc. of serosanguinopurulent fluid by a paracentesis pericardii. Cultures of

this fluid yielded a pneumococcus of no fixed type. . Following the paracentesis the boy showed temporary improvement, but the next day his condition had grown so much worse that it was decided to perform a low transsternal pericardiotomy, under 0.5 per cent procaine hydrochloride anesthesia. This was easily accomplished by making a 4-inch (1.8 cm.) incision upward from the apex of the ensiform cartilage in the midline of the chest. The incision was immediately deepened to the sternum, which was trephined with a Hudson burr just above the junction of the xiphoid process with the gladiolus, the site of the trephinement having been previously cleared of periosteum. The opening thus made in the sternum was enlarged with biting forceps. The posterior layer of the periosteum was now incised, and the pericardium came immediately into view. It was tense, distended, grayish, opaque and uncovered by pleura. The heart could be easily felt and was close to the pericardium. When the pericardium was incised, 1 pint of seropurulent fluid escaped. Two Dakin tubes were placed along the right side of the heart and anchored to the skin by sutures. The mediastinum was protected with a raw gauze tampon, and the wound in the skin closed down to the drains. The postoperative course was stormy. The boy's temperature gradually returned to normal; but his pulse continued rapid for a number of days. The cyanosis disappeared almost immediately, and the respiration, though rapid, was fuller and deeper. The discharge from the pericardium continued to be profuse, and after several days the pericardial sac was irrigated with gentian violet solution. He was discharged on July 12, 1924, and at present is in excellent health.

CASE 2.—A white boy, aged 18, was admitted to the hospital on Jan. 27, 1925, for postgrippal pneumonia. When he was admitted, however, signs of pneumonia could not be made out, and after watching him for some time and having made a number of roentgenograms of the thorax, we diagnosed the condition as pericardial effusion. As the effusion was not large, it was decided to perform a pericardiotomy without preliminary paracentesis pericardii. Accordingly, on Jan. 30, 1925, a trephine opening was made in the lower end of the middle portion of the sternum under 0.5 per cent procaine hydrochloride anesthesia. The pericardium was not distended, but its parietal lappet was thick, and considerable difficulty was encountered in opening it because it was in intimate relationship with the heart. When the incision was made, 150 cc. of seropurulent fluid escaped. The inner surface of the pericardium was somewhat shaggy. One small rubber tube was introduced into the pericardial sac along the right side of the heart and sutured in position. The patient was critically ill for a number of days. A culture of the blood was negative, and the fluid removed from the pericardium did not show any organism in the smear. Inoculation of mice two days later gave negative results. The youth improved gradually but steadily, and on the twelfth day after the operation, his temperature was normal both morning and night; the pulse rate was 80, and the respirations were 22. He was discharged from the hospital on March 1, 1925, in good condition, and has continued well since.

CASE 3.—A white boy, aged 19, developed an empyema of the right lung while in the medical service with pneumonia. On May 7, 1925, under 0.5 per cent procaine hydrochloride anesthesia, the seventh rib was resected just below the inferior angle of the scapula, and much pus was released. The patient became much worse on May 22, 1925, and the following morning a diagnosis of pericardial effusion was made. Pericardiotomy was performed after trephining the sternum, and a large quantity of thin, purulent fluid, somewhat blood-tinged,

escaped. The patient's condition was desperate, and he survived the operation only a few hours.

CASE 4.—A colored girl, aged 10, had been ill one week with influenza. When she was admitted to the hospital, she had a large pericardial effusion, and her condition was extremely grave. Paracentesis pericardii was not performed. Roentgen-ray examination of the chest showed both lungs clear and a large shadow in the cardiac region extending from well beyond the right margin of the sternum across the chest to a point outside the line of the left nipple. Pericardiotomy was performed by the transsternal route under local anesthesia. The girl failed to rally and died on April 4, 1925, the day following the operation.

CASE 5.—A white man, aged 23, eleven days before admission to the hospital was taken sick with pneumonia. On the fifth day of his illness, the fever, which had begun to decline, suddenly rose, and his condition became alarming. When admitted into the hospital on Jan. 18, 1926, he was critically ill; he was dyspneic; the pulse rate was 160, and it was running, of small volume and paradoxic; the blood pressure was: systolic, 100, diastolic, 60. The patient was somewhat cyanotic and had a slight cough, with practically no sputum. The left side of the chest was dull throughout. The right border of the heart extended almost to the line of the right nipple, the left merged with the general flatness of the left side of the chest. No heart sounds could be heard, but at the base of the sternum a pericardial friction rub could be distinctly made out. The abdomen was distended and tense, but not tender. A diagnosis of pericarditis with effusion was made. As the symptoms were urgent, it was decided to perform a pericardiotomy just as soon as the patient had had a few hours' rest. The operation was easily accomplished under 0.5 per cent procaine hydrochloride anesthesia. The pericardium was exposed by resecting the fifth, sixth and seventh left costal cartilages just lateral to the sternum. The internal mammary vessels were exposed and tied, and the pericardium readily came into view. On incising the pericardium, 2 ounces (62.2 Gm.) of thin pus escaped. The opening in the pericardial sac was enlarged, and a finger was introduced into it. No adhesions were felt. There was, however, a marked bulging inward of the left pericardial wall, which was tense. Two Dakin tubes were introduced into the pericardium, and the skin flap closed around these tubes. As a safeguard, the tubes were anchored to the skin by sutures.

A paracentesis of the left pleural cavity was performed, and 5,000 cc. of pus was withdrawn through the needle. This did not empty the pleural sac, but as the patient's condition was so grave, it was decided to do nothing further.

Following these procedures, the patient improved somewhat. His blood pressure rose to 120, and his pulse rate fell from 160 to 120. About fourteen hours after the pericardiotomy and paracentesis, a stab wound was made between the ribs, under local anesthesia, and a tube filled with water was inserted into the pleural cavity. The outer end of the tube was kept under water in a vessel beside the bed. This was done to prevent sucking, and during the next two hours, 3 quarts (14.3 liters) of pus drained from the left side of the chest. The patient's respiration was much relieved, but his general condition did not show improvement, and he died of exhaustion twenty-six hours following the pericardiotomy. A culture of the pericardial pus obtained at operation proved sterile.

CASE 6.—This patient, a white girl, aged 9, was taken ill with sore throat two weeks before operation. She was apparently making a good recovery when she suddenly developed severe pain in the abdomen. The condition was diagnosed as appendicitis, but on admission of the patient into the hospital, the diagnosis was changed to pneumonia. One week later, or two weeks from the onset of the

illness, a pericardial effusion developed. Roentgen-ray examination showed a large shadow, regular in outline, extending from just beyond the right margin of the sternum across the midline of the chest and well beyond the line of the left nipple. This shadow was broader below than above. The heart sounds were muffled and distant. A pericardial friction rub could not be heard.

Pericardiotomy was performed under 0.5 per cent procaine hydrochloride anesthesia. An incision was made parallel with the costal margin on the left side about 10 cm. in length, extending obliquely downward and to the left from the junction of the ensiform appendix with the second portion of the sternum. The incision followed closely the lower margin of the costal arch, and 5 cm. of the fifth, sixth and seventh costal cartilages were removed with rongeur forceps, close to the sternum. This exposed the internal mammary vessels, which were tied. The edge of the left pleura came into view. It was pushed aside, and, after the removal of a small amount of areolar tissue, the pericardium was exposed. It was easily differentiated from the pleura, as it was grayish, opaque and much thicker than the pleura. The anterior surface of the heart was quite close to the pericardium. On incision of the pericardium, there was a gush of thin pus, and 2 ounces (62.2 Gm.) escaped. A finger was introduced into the pericardial sac, but adhesions were not detected. Two Dakin tubes were placed in the pericardial sac, one on the left and the other on the right side of the heart, and to prevent them from slipping into the pericardium, they were sutured to the skin.

The patient did well for two weeks; the action of the heart improved, and the temperature fell. At the end of this time, however, she began to have an evening rise in temperature. This condition had continued for a week when another roentgen-ray examination showed a considerable shadow in the cardiac region, extending toward the left, which was interpreted as a walled-off pocket of pus in the left side of the pericardium.

With the patient under nitrous oxide anesthesia, a finger was introduced into the pericardium through the original incision. Some loose adhesions were broken up between the pericardium and the heart, and a pocket of pus was found rather high up and to the left. A Dakin tube was placed in this cavity. The child then made an uneventful recovery. She was seen three months after the operation, at which time she was in excellent condition.

CASE 7.—A colored girl, aged 12, was admitted to the hospital on Jan. 10, 1927, with brochopneumonia. She was apparently improving, but on January 18, the temperature rose to 101 F., the pulse rate to 130, the respirations to 40, and a definite friction rub was heard at the base of the heart. These conditions persisted until January 24, when it was noticed that the area of cardiac dulness had extended somewhat both to the right and to the left, associated with distant heart sounds and a leukocytosis of 20,000. Tubercle organisms were not found in the sputum, and the Wassermann reaction was negative. A tentative diagnosis of pericarditis with effusion was made, which impression was confirmed by a roentgenographic examination, and operation was advised. Diagnostic aspiration was not practiced, for fear of injuring the heart, as the exudate was thought to be scant.

Therefore, on Jan. 25, 1927, under 0.5 per cent procaine hydrochloride anesthesia supplemented by a few whiffs of nitrous oxide, an oblique incision was made, starting at the lower part of the body of the sternum and extending downward and laterally, thus exposing the left fifth, sixth and seventh costal cartilages, which were resected. The pleura was then pushed aside, and the pericardium incised, the internal mammary vessels having been ligated and divided in the meanwhile. The heart was fused to the anterior pericardial wall by rather firm adhesions, which were broken up by a finger. The surface of the heart was

shaggy and rough. Four ounces (124.4 Gm.) of serohemorrhagic fluid was liberated, which, on bacteriologic examination, showed pneumococcus. The edges of the pericardial incision were sutured to the lips of the subcutaneous wound, and a raw gauze tampon was introduced into the sac. The postoperative course was fairly stormy, the discharge soon changed to a thick, grumose pus, and the temperature, pulse and respirations did not reach normal both morning and night until February 8. From that time on the patient made an uninterrupted recovery and was discharged on March 16, 1927, as completely cured.

CASE 8.—A young colored man was admitted to the hospital on May 18, 1920, with pneumonia of the left upper lobe of a week's duration. Though the pneumonic process cleared up promptly, the patient continued to run a mild fever of obscure origin, accompanied by an accelerated pulse and rapid respirations. On June 5, 1920, roentgen-ray examination revealed a large, sharply defined shadow in the center of the chest, which was taken for a mediastinal abscess located in front of the heart. However, on June 7, a purulent pericardial effusion was suspected. Aspiration in the right fifth intercostal space, close to the sternum, recovered thick, greenish pus, from which the pneumococcus, type 4, was cultured, thus confirming the clinical impression of pyopericardium. An operation was performed on June 7, 1920, by Holland, under 0.5 per cent procaine hydrochloride anesthesia. The pericardial sac was approached through the right fifth interspace by 5-inch (12.7 cm.) incision. The right pleura was accidentally opened. It did not contain pus, but on the introduction of a finger into the opening a hard bulging mass was felt, which beat synchronously with the heart. A small hypodermic needle was inserted into the swelling, and pus was obtained. The pericardial sac was then incised, and 1 quart (4.3 liters) of thick, greenish pus escaped. A small rubber tube was placed in the pericardial cavity, and several gauze wicks were introduced to seal the pleural cavity. The postoperative course was smooth. The patient improved steadily and rapidly. The opening in the pericardium had closed on June 19, and the man was discharged from the hospital on June 24, 1920, in excellent condition.

CASE 9.—A white girl, aged 8, was admitted to the hospital on Nov. 18, 1925, for pain and tenderness in the left hip and in both wrists. Three weeks previously, she had had a small sore on the left heel, which had healed under treatment with home remedies. Ten days before, her left leg had begun to hurt, and for four days she had complained of chilly sensations, but had not had a definite chill. When she was admitted the pulse rate was 150; the respirations, 30; the temperature, 103 F. The leukocytes numbered 21,000, with a polymorphonuclear count of 80. The lungs and heart were normal. Roentgen-ray examination failed to disclose any disease of the bone or periosteum. As early as November 21, a staphylococcus was isolated from the blood stream. On November 24, an alternating friction murmur was detected at the base of the heart. The course was gradually but steadily downward. On November 29, the child's condition was so desperate that an intravenous injection of gentian violet was made, without any material benefit. On December 4, a roentgenogram of the chest showed a markedly enlarged cardiac shadow, which suggested a pericardial effusion. This impression was confirmed by the insertion into the pericardium of an aspirating needle through the left fifth space, with the liberation of pus, which yielded *Staphylococcus hemolyticus* on culture.

The operation was performed on Dec. 6, 1925, by Lynn, under ether anesthesia, by removing 1 inch (2.5 cm.) of the left fifth costal cartilage. The pericardium, which was easily recognized, was incised, and a large amount of sanguinopurulent fluid was released. This pus yielded *Staphylococcus hemolyticus* in pure culture.

A rubber drain was inserted into the pericardium. The pleura was not wounded. Following the operation, the patient showed little improvement, and a roentgenographic examination made on December 10 revealed a reaccumulation of fluid in the pericardium, with the cardiac shadow as large as ever. The wound was therefore reopened on December 12, and a large amount of fluid, which was in every way similar to that obtained at the earlier operation, was released. A Dakin tube was placed in the pericardium. The girl failed to rally, and died on Jan. 2, 1926, of pyemia. Autopsy was refused. The pericardium was irrigated on several occasions with normal physiologic sodium chloride.

CASE 10.—The data concerning this case were supplied by the surgeon, Dr. Harvey B. Stone, of Baltimore.

A soldier was admitted into Field Hospital no. 327 on June 27, 1918, with a diagnosis of: (1) bilateral lobar pneumonia; (2) pericarditis with effusion. On June 24, the pericardium was aspirated, and 400 cc. of fluid was withdrawn, but the nature of this fluid was not noted. He was transferred to Base Hospital no. 18 on July 11, 1918, at which time the following note was made: "pulse weak, regular, rapid; respiration increased, no pain." The whole left side of the back was dull on percussion. The left side in front was dull below the level of the nipple line and merged into the dulness of the liver with an obtuse angle. The left side of the back was aspirated, and the solid lung was encountered. A slight amount of bloody fluid was obtained, which yielded the pneumococcus. On July 29, the pericardium was aspirated in the right chondroxiphoid angle, and pus which yielded the pneumococcus, type 4, was obtained. On the same day, the pericardium was incised and drained under local anesthesia. The incision was made just to the right of the sternum, and the fifth costal cartilage was resected. The right side was chosen because the left side in front was resonant throughout, owing either to a lappet of the lung over the precordial area, or, more probably, to pneumothorax induced at the time of the first aspiration of the pericardium. The right pleura was opened and packed off, and the pericardium was then incised. A large amount of thick, creamy pus was evacuated. The edges of the pericardial incision were attached to the anterior wall of the chest by sutures. As a precaution, a small rubber tube was placed in the right pleural cavity to drain any empyema which might develop. The patient left the table in a precarious condition, with a scarcely perceptible pulse; his color was ashy blue, and his respirations were shallow and rapid. The pericardium was irrigated daily, first with normal physiologic sodium chloride, then after a few days with half strength and finally with full strength surgical solution of chlorinated soda. The tube in the right pleural cavity was soon removed, as that cavity never showed any signs of infection. The immediate postoperative course was alarming. The temperature ranged between 103 and 104 F., and the pulse was at times difficult to count. He gradually but steadily improved, and after August 10, his temperature became normal, both morning and night. He was evacuated to the rear on Aug. 25, 1918. At that time the pericardium had almost entirely ceased to drain pus. The daily irrigations came away practically clear. The wound in the chest had closed, so that it was just large enough to admit the catheter used for irrigation. The patient was up in a chair a number of hours daily, and was regarded as practically out of danger. A roentgenogram taken on July 13, showed the following: marked increase of cardiac shadow from the base to the great vessels of the neck, extending at the base laterally from nipple line to nipple line. Combined fluoroscopic and roentgenographic examination revealed that this area of increased density was due to a pericardial effusion. There was a distinct line of

demarcation at the anterior axillary line. This area of density suggested an effusion in the left pleural cavity at that site.

At discharge the left side of his chest had cleared up almost entirely. There was no dulness in the back and no signs of fluid or of consolidation. The right side showed a decreasing pneumothorax with a moderate amount of fluid at the base. In a letter several weeks afterwards, the patient reported himself practically well.

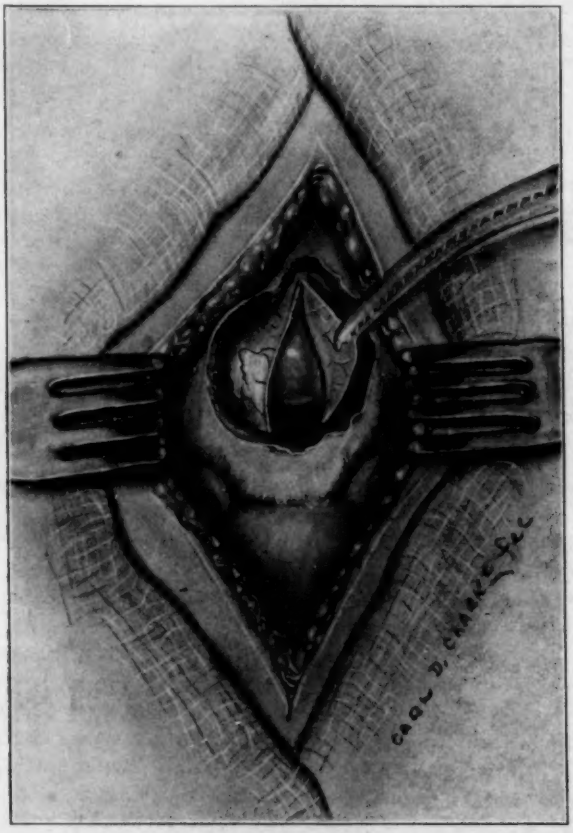

Fig. 1.—Transsternal pericardiotomy.

COMMENT

The ten patients in this series were operated on for purulent effusion of the pericardium, with six, or 60 per cent cures, and four, or 40 per cent deaths. These figures correspond closely with the general mortality rate for all patients treated by incision and drainage. In the first four cases, pericardiotomy was performed after the sternum had been trephined. The Hudson drill was used, and the opening was enlarged by rongeur forceps. The opening was made immediately above the junction of the second portion of the sternum with the ensiform

appendix. By using the rongeur forceps, the enlargement was made to the left of the midline. This method has a number of advantages. It can be done easily under local anesthesia, and the internal mammary artery is not encountered.

The vent in the sternum comes down directly on a small triangular area which usually is not overlaid by the pleura, so that the pericardium is immediately exposed after the removal of a small amount of areolar tissue that generally lies in this space. The most serious disadvantage of this method of approach is that the firm, unyielding walls of the opening in the sternum, to some extent, limit palpation of the pericardial sac by the examining finger, although this is less true in children than in adults. Bexman (1891) is the only other operator to use this approach for draining pus from the pericardium. He went through the sternum, however, at the level of the third costal cartilage. Bacon's experience at the autopsy table has impressed him with the comparative ease with which the pericardium may be explored through an opening in the sternum. He tabulates the advantages of this route, as follows:

1. It is anatomically correct.
2. It affords an easy approach to the pericardium.
3. It supplies the best possible drainage.
4. It permits ready inspection of the heart and pericardial cavity.
5. It is devoid of mechanical danger, such as hemorrhage and rupture of the pleura.
6. It can be done under gas anesthesia.
7. It requires only from five to fifteen minutes for its completion.
8. It does not leave deformity.
9. It offers the least possible chance of spreading infection to the pleural or to the peritoneal cavities.

In the four cases of our series in which it was used, it proved fairly satisfactory, but it was discarded in the later operations for avenues giving greater access to the pericardium.

In cases 5, 6 and 7, an oblique incision was made in the skin, parallel to the costal margin, extending for about 10 cm. from the base of the ensiform process toward the left. The incision through the underlying structures hugged closely the under surface of the costal arch, and with rongeur forceps about 5 cm. of the left fifth, sixth and seventh costal cartilages were removed. This approach exposes the mammary vessels, but no difficulty was experienced in ligating them and thus controlling bleeding from them. The margin of the left pleura invariably came into view, but this was easily pushed aside, and the pericardium was exposed. The pericardium was grasped with the forceps and incised. This route places the incision in the pericardium near its base, allows palpation of the left side of the pericardial sac and makes placing of the drains somewhat easier than in the approach through the sternum.

In cases 8 and 10, the pericardium was reached from the right side, once by resecting the fifth costal cartilage and on the other occasion through the fifth interspace. This route was selected in case 10, because the left side in front was resonant throughout. The pleura was opened in both of these cases without any untoward effects.

In case 9, the left fifth costal cartilage was resected.

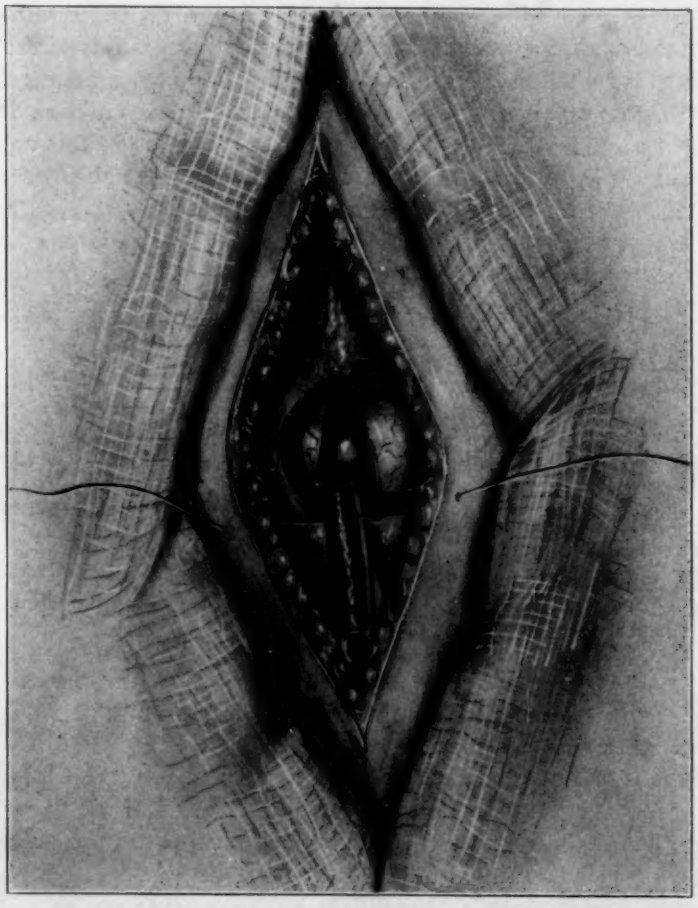

Fig. 2.—Drainage tube sutured in position after pericardiotomy by the sternal route.

In every instance the pericardium was thick and taut, and the heart seemed close to the anterior pericardial wall; so close that it gave the impression that there was no fluid in the pericardial sac. Several times it was difficult to grasp the pericardium with toothed forceps, in which event a small hook was found satisfactory. The pericardium is easily recognized, because it is gray, thick and opaque. It differs markedly from the pleura, which is thin and translucent.

If the transsternal route is chosen, care should be exercised not to make the opening too high, as this will expose the pericardium close to where it is reflected from the large vessels. The space here between the two layers of the pericardium is narrow, and drainage is not so satisfactory.

Though purulent pericarditis is not a rare lesion, and operation offers the patient his best, if not his only, chance, we could assemble but 128

TABLE 1.—*Etiology of Pericardial Effusion*

	Recovered	Died	Not Stated	Total
Pneumonia	18	14	0	32
Measles and pneumonia	1	0	0	1
Tonsillitis and pneumonia	1	0	0	1
Influenza and pneumonia	5	0	0	5
Pneumonia and pleurisy	2	0	0	2
Pneumonia and empyema	2	7	0	9
Influenza, pneumonia and empyema	0	1	0	1
Measles, pneumonia and empyema	1	0	0	1
Tonsillitis, pneumonia and empyema	0	1	0	1
Measles, pneumonia, pleurisy and empyema	1	0	0	1
Abscess, pneumonia, pleurisy and empyema	0	1	0	1
Empyema	2	2	0	4
Measles and empyema	1	0	0	1
Influenza and empyema	0	1	0	1
Tonsillitis and empyema	0	1	0	1
Nasal sinusitis and empyema	0	1	0	1
Pleurisy	1	2	0	3
Abscess, pleurisy and pyemia	1	0	0	1
Tonsillitis, pleurisy and arthritis	1	0	0	1
Puerperal sepsis and pleurisy	1	0	0	1
Tonsillitis and pleurisy	1	0	0	1
Pulmonary gangrene	0	1	0	1
Typhoid fever and congested lungs	0	1	0	1
Appendicitis (?), with pneumococcus in pericardial exudate	1	0	0	1
Whooping cough	0	1	0	1
Influenza	2	3	0	5
Osteomyelitis	5	8	1	14
Osteomyelitis, empyema, pneumonia and sepsis	0	1	0	1
Pyemia	1	4	0	5
Gunshot and stab wounds	12	0	0	12
Idiopathic	2	1	0	3
None given	4	3	0	7
Primary mediastinitis	0	1	0	1
Esophageal perforation	0	1	0	1
Gangrene of feet	1	0	0	1
Trauma to chest	1	0	0	1
Rheumatism	2	0	0	2
Tonsillitis, otitis media and arthritis	1	0	0	1
Total	71	56	1	128

instances of operative relief of the condition, of which number, 118 were gathered from the literature. In analyzing these cases, we find ninety-three operations were performed on men and twenty-seven on women; in eight cases, sex was not mentioned, thus giving a preponderance of men in the ratio of 3½:1.

Thirty-one were between 1 and 10 years of age; thirty-eight between 10 and 20 years of age; twenty-five between 20 and 30 years of age; fourteen between 30 and 40 years of age; four between 40 and 50 years of age, and one was between 50 and 60 years of age. In fifteen cases the age was not specified. Three of these patients were described as men; five, as soldiers and one, as a boy; six were not described at all.

Ninety-four were under 30, and sixty-nine were below 20 years of age. The largest proportion of these patients seen by the surgeon are under 30 years of age. The youngest patient subjected to operation was 1¾ years old, and the eldest, 56.

Only three cases were classified as idiopathic. In one of these, the pneumococcus was recovered from the pus removed by aspiration prior to operation, and in another a varied and numerous bacterial flora was recovered. In twelve, it was caused by the direct implantation of pyogenic organisms introduced from without by bullet or knife wounds.

TABLE 2.—*Results of Bacteriologic Examination*

	Recovered	Died	Total
Pneumococcus	12	9	21
Pneumococcus, type 1	1	0	1
Pneumococcus, type 4	2	0	2
Pneumococcus, no fixed type	1	0	1
Pneumococcus, type 4, later streptococcus hemolyticus, staphylococcus albus, gram-negative, nonmotile, nonliquefying bacillus and diphtheroid bacillus	1	0	1
Pneumococcus from empyema at autopsy	0	1	1
Pneumococcus in pus complicating so-called case of appendicitis	1	0	1
Streptococcus	8	2	10
Streptococcus, Staphylococcus aureus, also bacilli	0	1	1
Streptococcus nonhemolyticus from empyema, also staphylococcus pyogenes aureus, the latter probably a contaminator	1	0	1
Streptococcus and staphylococcus at autopsy	0	1	1
Staphylococcus	0	1	1
Diplococci of staphylococcic form, staphylococcus pyogenes albus from the blood stream	0	1	1
Staphylococcus hemolyticus	0	1	1
Staphylococcus pyogenes-albus	1	0	1
Staphylococcus pyogenes-aureus	3	2	5
Staphylococcus from pleuritic effusion	1	0	1
Staphylococcus from blood stream	0	1	1
Staphylococcus, next day rod-shaped bacteria	0	1	1
Staphylococcus, B. perfringens, enterococcus	1	0	1
Colon bacillus	1	0	1
Double coccus, not considered pneumococcus	0	1	1
Bacterial flora varied	0	1	1
Short bacillus, next day B. pyocyaneus	1	0	1
Rod-shaped bacteria, neither pneumococci nor streptococci	0	1	1
Rod-shaped bacteria	1	0	1
No organisms in smear; mouse inoculation sterile	1	0	1
Pus sterile	1	0	1
Total	38	24	62

In seven, the article gave no clue to the source of infection. In a few, the pericardial disease resulted from an extension of an inflammatory process in adjacent structures directly into the pericardium. In the majority of instances, however, the pyopericardium was attributed to a metastasis from a distant focus of infection. Osteomyelitis and pyemia were responsible for twenty of these cases, and diseases of the respiratory tract accounted for seventy-five. Of great interest in this connection was the incidence of pneumonia and empyema, either alone or in combination as a coincidental, primary or secondary process, one or the other or both having been noted in fifty-one cases.

Bacteriologic Examination.—Bacteriologic examination of the pus was made in sixty-two of these cases. In two instances, the exudate was sterile. In one case, the colon bacillus was responsible for the con-

dition. It had been introduced from without through a stab wound, however. A scattering of other organisms was mentioned, such as *B. pyocyaneus,* and *B. perfringens,* but the chief offenders were the pneumococcus, twenty-eight times; the streptococcus, thirteen times and the staphylococcus thirteen times. Death occurred in 37.03 per cent of the purulent pneumococcic pericarditic group, in 30.8 per cent of the streptococcic and in 53.8 per cent of the staphylococcic. Although it is not safe

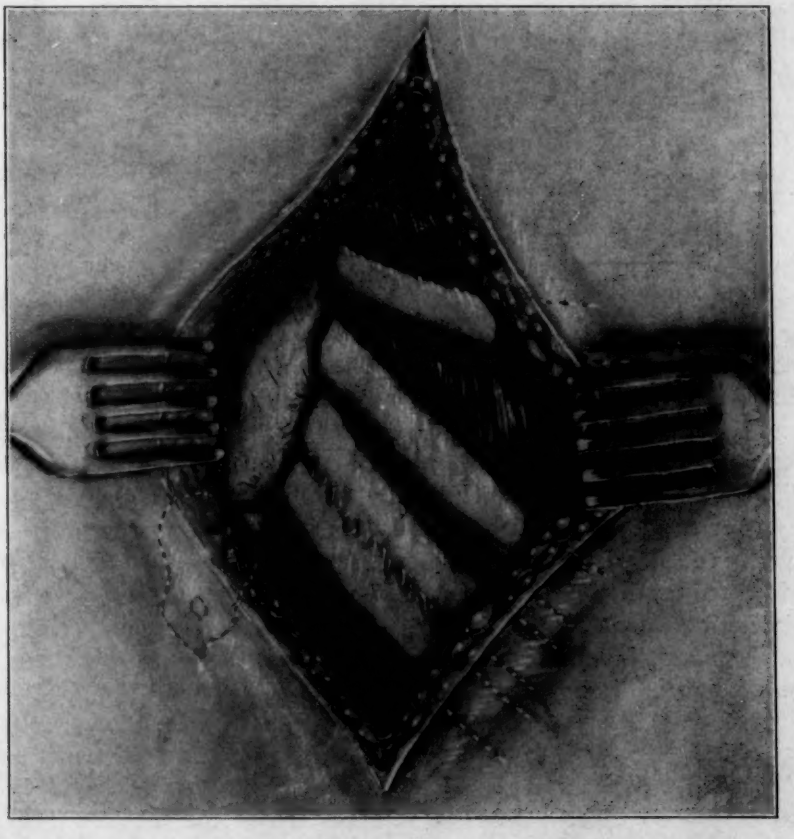

Fig. 3.—First stage in the xiphocostal approach for pericardiotomy.

to generalize from such a small series, these observations seem to indicate that the staphylococcic infection is the most deadly of the three.

Paracentesis.—Diagnostic puncture was practiced on eighty-six patients, without injury to the internal mammary artery, to the peritoneum or to the heart. Occasionally the pleura was traversed. In fifteen cases diagnostic puncture was not attempted, and in twenty-seven instances the report failed to mention whether the procedure was employed or not.

The sites usually elected for puncture were the left interspaces near the sternum from the second to the seventh, inclusive, more rarely the left fifth and sixth spaces just within the outer limits of pericardial dulness, the left costoxiphoid angle, the subxiphoid route, the right fourth and fifth spaces near the sternum and the right chondroxiphoid region. Occasionally the patient was tapped more than once, for either diagnostic or therapeutic purposes, but the latter invariably failed to render lasting benefit. On the other hand, many authorities condemn the use of the aspiration needle, first, as being too hazardous, and second, as unnecessary for making a correct diagnosis in the presence of the characteristic physical signs and roentgenographic evidence. If in doubt as to the nature of the disease, it is much safer, they claim, to cut down onto the pericardium and to enter this structure under direct vision rather than to jab a needle blindly into the chest with the possibility of entering the pleural cavity and thus instituting an empyema or of puncturing the heart and causing the death of the patient from hemorrhage. While there are numerous instances on record in which the heart has been punctured during an attempt to aspirate the pericardium, fortunately the accident is relatively uncommon, and, if it does occur, is ordinarily quite innocuous, but it may prove fatal (West). When a paracentesis pericardii has been definitely decided on, if pus is suspected, Pincoffs cautions that the needle should be introduced close to the sternum through the lowest possible interspace on the left side, with its point directed slightly downward and laterally so as to parallel the ventricles. Another strong objection to paracentesis is the obtaining of a dry tap, even in the presence of pus. Among others, Coutts had this experience, which tended to upset a diagnosis otherwise well established, and made him hesitate momentarily about sanctioning operative relief.

Aspiration is valuable only when fluid is liberated, but, as has already been intimated, it may prove a hindrance rather than an asset. In this connection, the question as to the situation of the heart when the pericardium is more or less full of fluid is of some moment. Brentano, from his clinical experience, declares that in all pericardial effusions the heart lies most often right against the anterior wall of the sac even if adhesions are not present, and that in many cases there will be a fusion between the pericardium and the anterior wall of the heart. This means that the heart is generally in a position easily reached by the needle and likely to be punctured unless excessive care is exercised when the needle is introduced. On the other hand, when aspiration fails to disclose the expected pus, if the clinical signs indicate its presence, adequate surgical measures should be promptly initiated, for, as a rule, the pericardial fluid lies behind the heart and is therefore out of reach.

Pus.—The amount of pus varied from a few drops to as much as 7,500 cc. Often the exudate was under high pressure and was described

on occasion as fetid, blood-stained, thin, turbid, thick, bright green, grayish yellow, creamy, inoffensive or cloudy. In the large proportion of instances, it had collected behind the heart and had pushed this organ forward directly against the anterior pericardial wall. In a few of the cases, the heart was attached to the pericardium by firm adhesions. Usually it was closely approximated to the pericardium, but on rare occasions a thin layer of pus was found interposed between these struc-

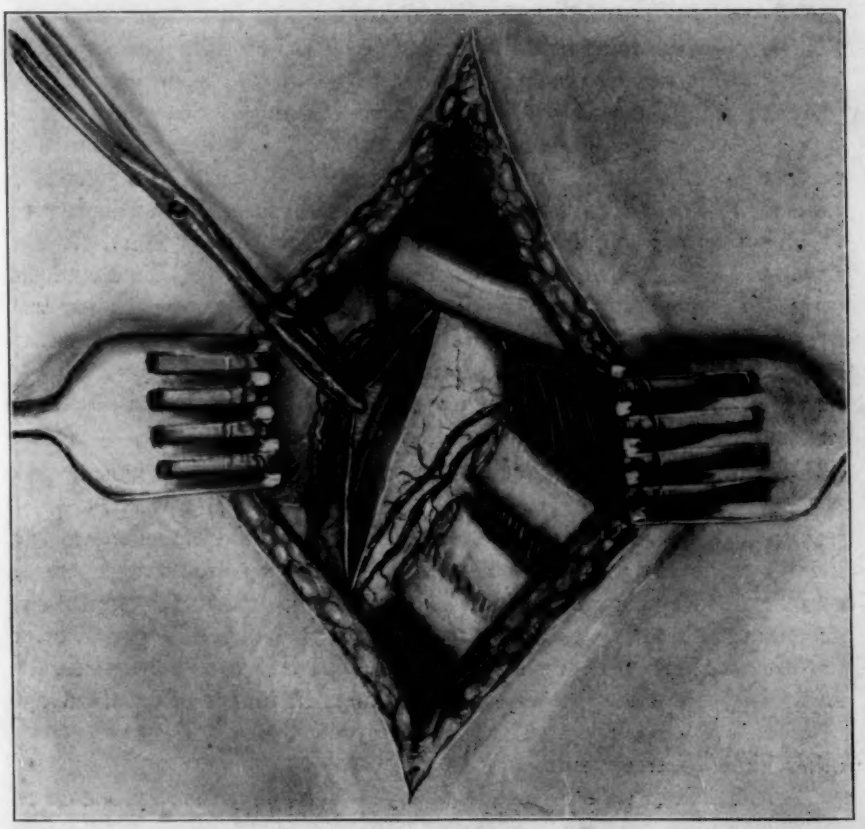

Fig. 4.—Incision into the pericardium through the xiphocostal route.

tures. For this reason, paracentesis is inadvisable, as there is considerable danger of injuring the heart. In four cases of this series, the fluid evacuated was potentially purulent, for it contained pyogenic organisms, and the discharge promptly changed to pus soon after drainage was established.

Diagnosis.—The question of a correct diagnosis depends largely on a recognition of those diseases in which pyopericardium is a complication. Then with a careful routine examination of the chest when the

patient is not doing well, supplemented by a roentgenographic examination of the thoracic viscera and, if deemed necessary, by a paracentesis pericardii, difficulty should not be experienced in arriving at a proper conclusion. In this series of 128 cases, diagnosis was made before operation in 116 instances, in two after opening the chest for the evacuation of a supposed pleural exudate, and in ten the time of diagnosis was not mentioned. Osler states that in spite of the clear-cut clinical picture, probably no other serious lesion is so frequently overlooked. In this connection, it is interesting to note that Stone found purulent pericarditis in forty-four, or 14.5 per cent of 300 autopsies performed on patients who died of pneumonia, none of whom had been operated on. A diagnosis apparently had not been made in any of these cases. Barkan and Lucas have gathered from a total of 3,248 autopsies, made at the Harvard Medical School from 1896 to 1911, six cases of suppurative pericarditis; of 324 cases of all types of pericarditis, Cowan discovered at necropsy twenty-four instances of the suppurative variety. In the cases of Craig and Mann, the abdominal symptoms so simulated an attack of appendicitis that the malady with which they were dealing was at first thus interpreted. One of the patients in our series was sent to the hospital by the attending physician under this impression. Fortunately, the error was soon recognized, and with the institution of proper medical measures, no damage resulted from the mistake.

Primary Operative Results.—Of the 128 cases herein collected, seventy-one patients, or 55.47 per cent, recovered; fifty-six, or 43.65 per cent, died, and in one case, or 0.78 per cent, the outcome was not mentioned. According to Rhodes, the death rate in patients not operated on or treated by aspiration alone is 100 per cent, and under similar circumstances Pincoffs estimates a mortality of well above 70 per cent for the purulent pneumococcic group. By comparison of these figures, the superiority of pericardiotomy is indisputable in that it offers a salvage of at least 50 per cent against, at best, only sporadic cases of recovery by other kinds of treatment.

A resection of a rib or costal cartilage was made in seventy-one cases. Of this number, forty-two, or 60 per cent, of the patients recovered, and twenty-eight, or 40 per cent, died. According to the preference of the surgeon, from the third to the eighth rib on the left side and the fourth and fifth ribs on the right were selected for this purpose, but the left fifth was the one commonly chosen. The approach was made through an intercostal space in thirty-nine cases, with nineteen, or 48.7 per cent, cures, and twenty, or 51.3 per cent, deaths. Of the remaining nineteen cases, five operations were performed by the transsternal route, with three cures and two deaths; one by a trap door, with recovery; two by incision at first and later a resection, with cures; one by incision through skin, insertion of a trocar and the institution of continuous suc-

tion, with recovery; in nine operations which were not described, three patients recovered, and five died, and in one case the result was not given. On the whole, it would appear from these figures that pericardiotomy through the resection of a rib is a slightly better procedure than through an intercostal space. At any rate, by affording more room, it adds greatly to the comfort of the surgeon and lessens rather than increases the operative hazards.

The question of recovery seems, however, to depend more on the etiology of the lesion than on the method by which the pericardium is attacked. There were twelve cases of gunshot or stab wounds, with 100 per cent cures; fifty of pneumonia, with 50 per cent cures; seventy-five of respiratory lesions, with 49.3 per cent cures; eight of pyemia, with 37.5 per cent cures, and fifteen cases in the osteomyelitic group, with 33.33 per cent cures.

Symptomatology.—Those interested in this phase of the subject should consult the table with abstracted case reports. Therein will be found in sufficient detail the subjective and objective observations as recorded in the original sources. According to this table, enlargement of the area of precordial dulness occurred ninety times; rapid pulse, fifty-nine times; quickened respiration, forty-one times; distant and weak heart sounds, fifty times; elevated temperature, fifty-eight times; normal temperature, six times; inaudible heart sounds, seven times; paradoxical pulse, ten times; enlarged and displaced liver, sixteen times; epigastric tenderness and pain, fifteen times; apex beat not palpable, twenty-four times; bulging precordium, eleven times; dyspnea, fifty times; cyanosis, either local or general, forty times; friction rub, twenty-six times; absence of friction murmur, eleven times and leukocytosis, thirteen times.

Many of the case reports are meager, however; therefore, they are of little value for statistical purposes. Of particular interest clinically is the occasional absence of fever (Speed, Stoker, McConnell). Not much reliance can be placed on the presence of the friction murmur, as it is fleeting and has often disappeared, if it has been present, before the examination of the patient has been made. In spite of a large effusion, it was noted by Gluck in one of his cases. Of the utmost value is the bottle-shaped roentgenographic shadow in the center of the chest. The roentgen ray was first used for this purpose by Napalokow on March 7, 1902. It is mentioned as having been employed in thirty of the cases comprising this series.

Open drainage at the earliest possible moment, as advocated by Gaston, appears to be the best way of handling this malady. Unfortunately, a careful analysis of the material available is not in accordance with this view, for of the ninety-six patients operated on within from a few days to eight months after the diagnosis was made, fifty-six, or 58.47 per cent,

recovered and forty, or 41.6 per cent, died; of thirty-six patients operated on within a few days, twenty, or 55.5 per cent, recovered and sixteen, or 44.5 per cent, died; of sixty-one patients operated on within less than two weeks, thirty-four, or 55.7 per cent, recovered and twenty-seven, or 44.3 per cent, died; of seventy-eight patients operated on within two weeks, forty-five, or 57.5 per cent, recovered and thirty-three, or 42.3 per cent, died; of eighteen patients operated on after two weeks, eleven, or 61.1 per cent, recovered and seven, or 38.9 per cent, died.

Regardless of the time which has elapsed between the diagnosis and the operation, the proportion of cures maintains a fairly uniform level. Some factor other than early operation must, therefore, be the determining influence as to whether the patient is to live or to die. In this connection, however, Klose and Strauss voice the opinion that it is best to operate before the exudate has changed to pus. They claim that suppurative pericarditis may be prevented, even in the presence of pyogenic organisms, if such a policy is adopted, and they furnish as substantiatory evidence a patient treated by them in this manner with success. The experience of Brooke [1] would seem to support this contention. Thirty-six cases of pericarditis secondary to osteomyelitis have been recorded, he says, in which drainage of the pericardium was performed. Recovery after operation took place in two instances only. He attributes this high mortality to delay in operative intervention. For example, in twenty of the thirty-six cases, pericardiotomy was performed in from three to ten days after the fluid in the pericardium had been definitely diagnosed clinically. A good illustration of this is seen in the case of the child who was admitted into the hospital with an acute osteomyelitis of the left femur, for which immediate operation was performed. Eight days later, the boy did not show any signs of improvement, and examination of the chest revealed the presence of a pericardial effusion, for which paracentesis was performed. Turbid serum was drawn off, but at the end of forty-eight hours micro-organisms were not found. Ten days later, the pericardium was again aspirated. This time pus teeming with *Staphylococcus pyogenes-aureus* was obtained. Pericardiotomy followed, with death twenty-four hours later. Other pyemic foci were not found at autopsy. The other examples are all similar in that the pericardiotomy was delayed until puncture of the pericardium revealed a purulent change in the pericardial fluid. The records of the two cases in which recovery ensued are here given. Both patients were operated on while the caudate was still turbid.

1. We have not included any of Brooke's cases in the tabulated list of pericardiotomies because the author has failed to state whether they were collected from the literature or were original observations. From the contents of the article it was impossible for us to decide this question and rather than to duplicate cases, we give them in a supplementary table.

A boy, aged 11, had osteomyelitis of the right tibia. An operation was performed immediately. Eight days later, the patient's condition was much the same, and for the first time a pericardial rub was heard. On the third day, it had disappeared, and there were definite signs of fluid in the pericardium. On the twelfth day after admission, the cardiac area was enlarged both to the right and to the left. The pericardium was tapped, and a slightly turbid fluid was drawn off. As this was thought to contain pus, an immediate pericardiotomy followed; subsequent bacteriologic examination of the fluid demonstrated the surprising fact that it was sterile. Twelve hours afterward, the wound was discharging pus containing a rich growth of *Staphylococcus pyogenes-aureus.* Three months later, the boy was capable of doing a fair amount of exercise. No signs of adherent pericardium were present.

The second patient, a boy, G. H., aged 12, was admitted to the hospital for an acute osteomyelitis of the left fibula, and operation followed promptly. Subsequently, further osseous foci developed and were incised and drained. On the twenty-eighth day after the boy was admitted, a distinct rub was heard over the heart; it disappeared six hours later. Meanwhile the limits of cardiac dulness were extending, and signs of pericardial fluid were well marked. Twelve hours later, a needle was inserted in the pericardium, and a slightly turbid fluid was withdrawn which proved to be sterile. At the time, the exudate was thought to be infected, and pericardiotomy was performed, a rubber tube being left in situ. Four days after the operation, the fluid escaping from the drainage tube was distinctly purulent, and when examined microscopically it revealed *Staphylococcus pyogenes-aureus.* At the time of the report, the boy was recovering rapidly, he was up and walking about the ward and had no signs of adhesive pericarditis.

In case 7 of our series, the fluid was serohemorrhagic, and the patient recovered satisfactorily.

Here, then, are four cases in which the exudate was infected but nonpurulent, and in which all the patients recovered. The question naturally arises, should this be the line of treatment invariably pursued in cases of exudative pericarditis potentially purulent? The evidence seems to be in favor of such treatment, but the answer to the problem must await further experience. These are desperate cases, and anything that holds the promise of a lessened death rate should be given an extended trial before it is rejected.

Our investigations would lead us to believe that after the exudate has become distinctly purulent a reasonable delay does not compromise materially the chances of recovery. When the disease has become fully established, it would appear that the only hope for lessening the mortality rate is the early recognition and prompt evacuation of attendant purulent foci. No matter how well or at what stage pericardiotomy is performed, it fails to succor if an abscess in the pleural cavity is overlooked, or if secondary collections of pus in the pericardial sac escape detection. Occasionally a second intervention may be found necessary to relieve a pocketing of the pus, for better drainage or to prevent blocking of the drainage tube. Of the 128 cases collected herein, this happened in eleven, namely, once each in cases reported by Porter,

Ljunggren, Byles, Peters, LeConte, Pool, Wood and Bradley, Lynn, Winslow and Shipley, Quincke and Halsted, with six recoveries and five deaths. Porter, Ljunggren and Quincke first obtained drainage in their cases by an intercostal incision, then some time later were compelled to resect a rib to obtain better drainage. Peters made an intercostal incision which had to be repeated two days later, because the drainage tube had become blocked. LeConte had the same experience. Wood and Bradley, Pool, Lynn, and Winslow and Shipley reopened the wound, inserted a finger and released some reaccumulated pus. Byles incised down to the pericardium and aspirated some pure blood. Then he closed the wound, but he reopened it later, incised the pericardium and evacuated pus. As his patient was not doing well, Halsted introduced a finger into the pericardium, but could not detect any reaccumulation of pus.

On occasions, though fortunately rare, the heart has been noticed to cease beating as the pericardium is incised. This peculiar phenomenon, spoken of as cardiac "still-stand," has occurred in cases reported by Harrigan, Metivet and Ljunggren. In Harrigan's case, the temporary arrest of the heart was relieved by the placing of drains, but the heart stopped permanently four days thereafter. Metivet had a strikingly similar experience. With the injection of epinephrine into the cardiac musculature, pulsation returned, but ceased permanently in half an hour. Ljunggren also reports a heartblock which behaved precisely like those in the preceding two cases. The heart lay motionless in its sac, but on compression of the left ventricle it began to pulsate again. A year later the patient was alive, with the area of cardiac dulness within normal limits. More than one instance is recorded in which an incision or puncture evacuated the pericardial effusion into or through the left pleural cavity. In some cases a thoracotomy was performed for a supposed pleural exudate, but a distended pericardium was found to exist and was then tapped through the original wound. West, Savory, Lane, and Steward and Garrod have recorded cases illustrative of this mistake.

While the closed method for withdrawing a pericardial exudate, as devised, described and practiced successfully by Whittemore, may not come strictly under the category of a pericardiotomy, it is nevertheless akin to that procedure, in that the surgeon exposed the pericardium through an open incision before puncturing the wall of the sac. It is applicable only before large masses of fibrin have formed; otherwise some one of the open procedures must be employed.

The presence of an empyema was diagnosed in sixteen patients, of whom seven recovered and nine died following thoracotomy. On eight occasions this complication was overlooked entirely and was not suspected until autopsy. It is only reasonable to assume that a few patients

in the latter group would also have recovered, if they had had the advantages of a pleural drainage.

Six of the patients developed pleurisy with effusion, in three of whom the condition was found at autopsy. Of the remaining three, two recovered and one died.

Secondary Operative Results.—Operative intervention for pyopericardium has been condemned as unwarranted on the grounds that if the patient escapes with his life he will sooner or later develop a fatal

TABLE 3.—*Pleural Complications: Empyema*

Case No.	Side	Operated on	Discovered at Autopsy	Recovered	Died
3	Left	Yes	....	Yes	....
11	Right	No	Yes	....	Yes
12	Left	No	....	....	Yes
21	Bilateral	No	Yes	....	Yes
26	Left	Yes	....	....	Yes
27	Left	Yes	....	....	Yes
33	Left	Yes	....	....	Yes
35	Left	Yes	....	Yes	....
42	Bilateral	Yes	....	....	Yes
48	Left	No	Yes	....	Yes
54	Right	Yes	....	....	Yes
58	Left	Yes	....	Yes	....
64	Left	Yes	....	....	Yes
66	Right	No	Yes	....	Yes
73	Left	No	Yes	....	Yes
81	Right	Yes	....	....	Yes
82	.....	Yes	....	....	Yes
91	Left	No	Yes	....	Yes
92	.....	Yes	....	Yes	....
96	Left	No	Yes	....	Yes
110	Right	Yes	....	Yes	....
116	Left	Yes	....	Yes	....
121	Right	Yes	....	Yes	....
123	Left	Yes	....	....	Yes
21	.....	16	7	7	17

Case No.	Pleurisy Side Tapped and Times		Discovered at Autopsy	Recovered	Died
7	Right	....	Yes	....	Yes
8	Left	....	Yes	....	Yes
10	Right	....	Yes	....	Yes
13	Left	12	....	Yes	....
112	Left	Yes	....	....	Yes
115	.....	....	....	Yes	....
6	.....	2	3	2	4

obliterative pericarditis. In such cases death is delayed but not stayed, and life is prolonged only for a shorter or longer period at the expense of a crippling invalidism, unless the patient is relieved by cardiolysis, a dangerous procedure in itself and as yet too recent a development to have established its real status. Fortunately, twenty-nine cases are available in this series which throw considerable light on this phase of the subject. Instead of supporting the commonly accepted opinion that adherent pericardium is an inevitable consequence, they appear to supply ample proof to the contrary. In all of these cases, at least five months had elapsed since the operation, and in one as long as twenty-one years had supervened. Our investigation shows that twenty-five of

these patients were alive, well and at their usual vocation at the time of the report, with their cardiac boundaries within normal limits. One was still alive, but had developed an adhesive pericarditis, and his death was momentarily expected (Davis). Of the three remaining patients, one had died three years after the pericardiotomy, but as the patient had passed from the care of the operator, the cause of death could not be

TABLE 4.—*History of Patients Living Five Months or More*

Time	Case No.	Comment
5 months	9	**
	41	Moderate degree of cardiac hypertrophy, but no signs of adhesive pericarditis
6 months	20	In excellent health and attending school, no symptoms referable to heart or lungs
	67	At work
	109	Capable of any task, even the most laborious
8 months	110	In normal health and able to exercise without embarrassment
1 year	31	Quite well and at work
	35	In excellent health
	37	Area of cardiac dulness within normal limits
	53	Alive and in good health
	58	Could play as well as ever
	63	Well and doing light work; no dyspnea; no retraction of interspaces over or behind cardiac area; outline of cardiac dulness normal; apex beat in fifth space within midclavicular line; no venous pulsation in neck; no signs of adhesive pericarditis
	80	Died of a recurrence of an abscess of the brain
	98	On roentgen-ray examination, heart boundaries were normal with systolic retraction of precordial region except at the apex, where a positive pulsation was seen just inside left nipple line; absolute cardiac dulness; left border showed a mitral configuration; right border not demonstrable. This meant adhesive pericarditis was in association with chronic mediastinitis and fusion of pericardium with pleura to wall of the chest. Author says that this is an excellent example of postoperative result, which shows why the prognosis is unfavorable
	117	In good health; scar retracted slightly with each systole; no retraction at apex
	124	In excellent health
2 years	22	Heart in normal limits; patient well
	32	Was enjoying good health
	38	Heart normal
	120	In excellent health
3 years	30	Died 3 years later, but author did not know cause of death
	119	In excellent health
3½ years	29	No retraction of spaces with systole; heart sounds normal
8 years	5	Perfectly well; no signs of adhesive pericarditis, had been for years in active work and was capable of any ordinary muscular effort
	56	Entirely well
9 years	65	Heart in its normal limits; its tone full and pure; pulse regular
21 years	49	In good health
Not stated	114	Died later of adhesive pericarditis

ascertained (Eiselsberg); one had died of abscess of the brain a year later (Johnson in Godlee) and one of adhesive pericarditis (Darrach).

Thus only two, or 7 per cent, of twenty-nine patients had developed intrapericardial adhesions in such a degree as to cause baneful symptoms. In the light of these observations, it would appear that the occurrence of adhesive pericarditis is not as common as heretofore supposed.

It is true that other cases might have come in this category, had the patients lived. For instance, in case six of our series, it was necessary a few days after the pericardiotomy to insert a finger into the wound. Some pocketed pus and a few loose adhesions were detected, and the adhesions were broken up. A year afterward the patient was well and

did not show any evidence clinically of impaired action of the heart. It is too soon to predict the ultimate outcome, but from present appearances the child is completely cured.

Pool had a similar experience, but his patient died thirteen days after the pericardiotomy. In our case, seven firm, dense adhesions were found sealing the heart to the pericardium anteriorly at operation. This patient is now convalescent, but at present it is impossible to foretell whether the adhesions will or will not reform. Savory, Delorme, Sievers, Stoker and Allingham found an extensive adhesive pericarditis in their cases at autopsy, but none of these patients had survived operation as long as a month.

Drainage.—Table 5 gives an idea of the material used and the method of carrying on drainage. Somewhat more than half the opera-

TABLE 5.—*Drainage*

	Outcome			
	Recovered	Died	Unknown	Total
Tubes	34	26	0	60
Tubes, but discontinued because of irritating heart	0	1	0	1
Tube, but 1 year later adhesive pericarditis	1	0	0	1
Dakin tubes	2	1	0	3
Gutta percha, then tube	0	1	0	1
Gauze, then tube	0	1	0	1
Rubber tissue or gutta percha	1	2	0	3
Glove drains	1	0	0	1
Cigaret drains	1	0	0	1
Drain protected by condom	1	0	0	1
Gauze, then gauze in tube	1	0	0	1
Plain or iodoform gauze	8	5	0	13
Wound left open	4	2	0	6
Pericardium stitched to wound and gauze wick placed in sac.	1	0	0	1
Pericardium stitched to wound and gauze wick placed in sac, later tube substituted	1	0	0	1
Not described	14	17	1	32
Not described, died 1 year later of adhesive pericarditis	1	0	0	1
Total	71	56	1	128

tors showed a preference for tube drainage. Usually two tubes were employed, one placed in the culdesac on either side of the heart. Next in popularity came either raw or protected gauze drains. In six cases the wound was left open, and no artificial drainage was used. In another the edges of the pericardium were stitched to the wound, with a gauze wick placed in the sac first, but later replaced by a tube. In still another the wound was left open, the pericardium was stitched to the muscles and a piece of gauze introduced a short distance into the sac. In those cases in which the pericardium was stitched to the muscle or skin, a slightly longer time elapsed before the complete closure of the wound occurred; on the whole, there is not much choice between the methods enumerated, all being attended with about the same percentage of primary recoveries.

Lindner, Lane and Lilienthal had to discontinue tube drainage because it impinged on the heart and by irritating it caused a stormy and irregular action. Riedel and Eichel, in pericardiotomies performed for other purposes than a pyopericardium, noticed the same phenomenon.

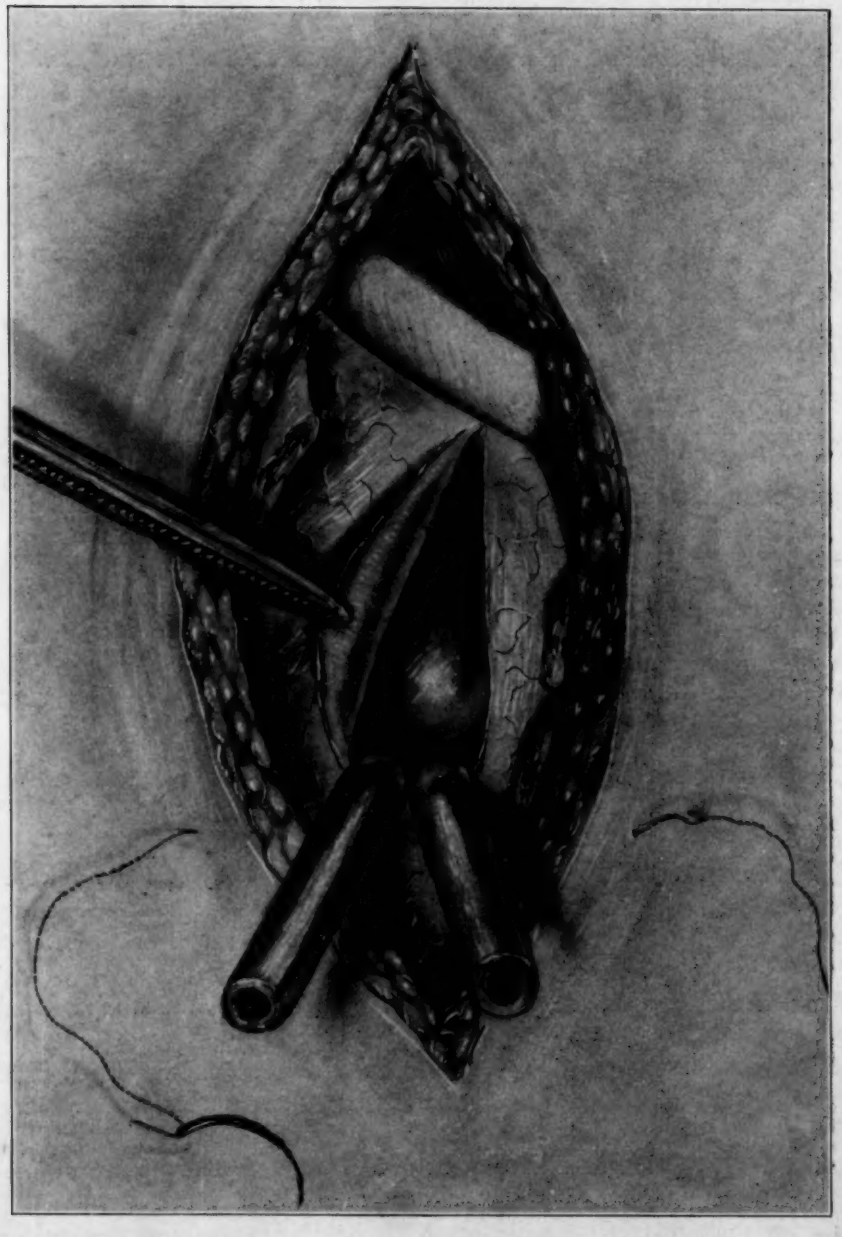

Fig. 5.—Tubes sutured in position in the xiphocostal approach for pericardiotomy.

In Underhill's case, a sharp hemorrhage occurred from the drainage tube two days after the pericardiotomy. This was repeated at intervals until the death of the patient.

Irrigation.—Irrigation was used in forty-five of the cases; twenty-four patients recovered, and twenty-one died. The solutions used were: 3 per cent salicylic acid solution; 1 per cent phenol solution; thymol solution; Condy's fluid; boric acid solution; tincture of iodine, 1 to 10; 0.5 per cent lysol solution; iodoform in glycerine; normal solution of physiologic sodium chloride; bicarbonate of soda solution; sterile water; eusol;[2] mercuric chloride solution in a dilution of 1 :5,000; gentian violet and surgical solution of chlorinated soda.

In sixty-three instances the question of irrigation is not mentioned. Of these patients, thirty-nine recovered, twenty-three died, and in one case the outcome is not given. In one of the recoveries adhesive pericarditis had occurred, and death was predicted; in another of the recoveries death occurred later from adherent pericarditis. It is specifically mentioned in twenty cases that irrigation was not employed. Eight patients recovered, and twelve died.

Parker's experience illustrates aptly the importance of making provision for the return flow of the irrigating fluid. After the pericardiotomy in his case, the pus did not flow well. It was thick and contained membranous shreds. Irrigation was practiced, but the opening in the pericardium became plugged with lymph, and the pressure of the trapped fluid on the heart proved fatal. Rhodes had a similar experience. While he was washing out the pericardium, the catheter became plugged; the patient grew cyanotic, gave a few convulsive jerks and was apparently dead. The catheter was pulled out; this was followed by a gush of irrigating fluid. Respirations began immediately, and in a few minutes the patient was apparently as well as previously, but he died several days later. Pool, Wood and Bradley, and Stone used surgical solution of chlorinated soda apparently with satisfaction. Jopson used it with great trepidation, and in fact had to discontinue its use because it was not tolerated.

Prognosis.—The prognosis, though always grave, is by no means hopeless. Even in apparently moribund patients, striking cures have occurred. Twenty-five patients of this series were so listed, with fifteen recoveries and ten deaths. Of much significance from a prognostic standpoint is the etiologic element. Those cases caused by the introduction of pyogenic organisms directly from without, as from a nonsterile instrument, in which the disease was therefore limited to the pericardial sac, give the best percentage of recovery. The pneumococcic variety

2. Preparation of eusol was described in "Queries and Minor Notes," J. A. M. A. **74**:413 (Feb. 7) 1920.

TABLE 6.—*Mortality Census*

Case No.	Survived Operation	Clinical Impression	Autopsy	Comment
4	20 hours	Pleuritis	Pus in pericardium; fatty degeneration and dilatation of heart; miliary abscesses in lungs and liver	Died in collapse
7	15 days	Pyemia	Abscess in the left thigh; no pus in pericardium; left lung completely collapsed; right serous pleurisy, adhesive pericarditis	During course of disease had normal temperature part of time
8	14 days	Pyemia	Abscess in the left thigh; inflamed left ankle; serous fluid in the left pleura; obliterative pericarditis; mediastinitis	
10	18 hours	Pyemia	Fatty degeneration and dilatation of heart; fibrinosanguinopurulent exudate in pericardium; right hydrothorax; obliterative left pleuritis; edema of lungs; purulent bronchitis; thrombosis of pelvic veins; necrosis of kidneys	
11	18 days	Typhoid; congested lungs	Terminal pneumonia; right empyema; left pleural effusion	
12	6 days	Osteomyelitis; pyemia	Left empyema; granulation tissue on inner surface of pericardium; death attributed to pyemia and hemorrhage from pericardium	Two days after pericardiotomy, hemorrhage from drainage tube; ceased spontaneously and recurred with greater or less severity for 6 days, when patient died of exhaustion
14	Died on table	Osteomyelitis	Nothing of importance.....	Died during operation from trapping of irrigating fluid
15	13 days	Influenza; arthritis	Small amount of pus and large amount of fibrinous exudate in pericardium	Death attributed to myocarditis
16	17 days	Osteomyelitis	No autopsy.....	Death attributed to pyema
17	Few minutes	Influenza; empyema	Heart adherent to whole anterior surface of pericardium; seropurulent fluid in lower and back part of pericardium	Death attributed to asphyxia
19	26 days	Influenza; pneumonia; empyema	No autopsy.....	
21	7 days	Osteomyelitis; pneumonia; pyemia	Bilateral empyema; no pericardial adhesions	Death attributed to syncope and pyemia
23	25 days	Pneumonia	Thrombosis left innominate and jugular veins; myocarditis; pyopericardium	
24	12 days	Osteomyelitis	Numerous abscesses in wall left ventricle communicating with pericardial sac; miliary abscesses of kidneys; caseous focus in lung; evidence of pleurisy	Death attributed to heart failure and pyemia
25	6 days	Influenza	Pericardium empty; pus in right ankle and right sternoclavicular joints	Death attributed to sepsis
26	8 days	Pneumonia; empyema	Pus in pericardium; bilateral empyema; adhesive pericarditis; acute nephritis	Died in collapse; in the meantime had had thoracotomy for empyema of left lung
27	.....	Primary	Yes	In light of autopsy, disease believed to have originated in anterior mediastinum
33	17 days	Pneumonia	Left pleurisy, infarcted lung, murky fluid in pericardium	In meanwhile thoracotomy for empyema

TABLE 6.—*Mortality Census—Continued*

Case No.	Survived Operation	Clinical Impression	Autopsy	Comment
36	30 days	Pneumonia	Pericardial adhesions; some pus in pericardium; atelectatic right lung; serum in left pleural cavity; nutmeg liver; infarcts in both kidneys	Death attributed to heart failure
42	17 days	Pneumonia	Pus in pericardial sac; bilateral empyema	Thoracotomy for bilateral empyema performed in the meantime; died in collapse
43	.....	Osteomyelitis	Multiple abscesses in the muscle of the heart	Death attributed to pyema
45	20 days	Empyema	.....	Death attributed to exhaustion; had had empyema 1 year before
46	12 days	Pneumonia; empyema	Yes.....	
47	3 days	Broncho-pneumonia	No autopsy.....	Death attributed to collapse
48	14 hours	Empyema	Pericardium and both lungs firmly adherent to the wall of the chest, heart adherent to pericardial sac, disease appeared to have originated from a collection of inspissated pus lying between sac and left lung	Death attributed to weakness
50	Few days	Pneumonia		
54	19 days	Pneumonia	No pus in pericardium; on the left side pneumonia; fibrosis of the right lung	Death attributed to collapse
55	52 hours	Osteomyelitis; suppurative peritonitis	.....	No operation for peritonitis as child's condition did not warrant it
57	Ultimately	.....	.....	Death attributed to general streptococcic infection
59	6 days	Pyemia	.....	Disease followed a miscarriage
60	16 days	Pneumonia	Yes.....	Death attributed to exhaustion
62	2 days	Tonsillitis; pneumonia; empyema	Number of small abscesses in heart with some bleeding both into pleural and pericardial cavities	Pyopericardium discovered and drained through empyema cavity
64	1 month	Pneumonia; empyema; measles	Gelatinous deposit in anterior mediastinum; abscess between the heart and left pleura	In the meantime had had right thoracotomy for empyema; died of inanition
66	1 week	Pneumonia	Pyopericarditis; right empyema; suppurative peritonitis	
69	2 days	Measles; pneumonia	Gelatinous pus covering both layers of pericardium; diphtheritic laryngitis	Diphtheria had not manifested itself during life
70	Later	Osteomyelitis	.....	Death attributed to secondary osteomyelitic processes
73	Eventually	Whooping cough	Abscess at the base of the right lung; empyema of the left lung; pus in the pericardium	
81	13 days	Pneumonia	.....	During convalescence had thoracotomy for empyema of right lung
82	.....	Pneumonia	.....	During convalescence thoracotomy for empyema

TABLE 6.—*Mortality Census—Continued*

Case No.	Survived Operation	Clinical Impression	Autopsy	Comment
90	4 days	Osteomyelitis; empyema; pneumonia	No autopsy	Death attributed to pyema; when sac was opened, heart lay still, but beat again with placing of drain
91	1 month	Pneumonia	Pyopericardium; empyema on the left side, thrombosis of right internal jugular vein and of left renal artery	Blood culture yielded staphylococcus pyogenes albus
94	8 days	Pleurisy	Abscesses in lung, spleen and liver; thrombosis of splenic vessels and subclavian artery	While washing out sac, catheter clogged up, patient gasped and was apparently dead, but with release of fluid he revived
95	Several days	Pneumonia	Purulent mediastinitis and pyopericardium	Died with symptoms of cardiac compression
96	5 days	Esophageal perforation	Fistulous tract between pericardium and esophagus caused by broken-down tuberculous gland; seropurulent exudate in left pleura; encysted tuberculosis in right lung	
99	13 days	Pneumonia	Phlebitis of right leg; heart sealed to pericardium	Blood culture yielded Staphylococcus aureus; autogenous vaccines used
100	17 days	Pneumonia	Bilateral hypostatic pneumonia; calcified tuberculous focus in the right lung	Absence of fever during patient's stay in hospital
102	.....	Pulmonary gangrene		
104	Few hours	Pneumonia		
112	8 weeks	Nasal sinusitis; empyema	.....	Antistaphylococcic serum used
118	On table	Idiopathic	Perforation in pericardium communicated with a bronchus	Antigangrenous serum administered; died during operation
121	Few hours	Pneumonia; empyema	No autopsy	
122	1 day	Influenza	No autopsy	
123	1 day	Pneumonia; empyema	No autopsy	
127	27 days	Pyema	Autopsy refused	

yields 50 per cent of cures in round numbers, while the streptococcic and the staphylococcic types have the least favorable prognosis. When the pericarditis is an expression of a generalized septic process, the field for successful operative intervention seems to be small; yet, limited as it is, it affords the sole chance of averting a fatal issue. On the other hand, practically all patients not operated on or treated only by aspiration die. Complications of necessity fatal in themselves, unless detected early and promptly remedied, render the prognosis less favorable. Preeminent among these is empyema. It was listed as having occurred twenty-four times. Sixteen of these patients were operated on; seven recovered, and nine died. In the other eight instances, the empyema was discovered at the autopsy table. Occasionally it has been found necessary to reopen the wound and to introduce a finger into the pericardial sac for

the relief of secondary pockets of pus. While the mortality is high, cure has been effected even under such unfavorable circumstances.

By referring to table 6, it will be seen that of the first twenty-five patients, ten, or 40 per cent, recovered, and fifteen, or 60 per cent, died; of the second twenty-five patients, twelve, or 48 per cent, recovered, and thirteen, or 52 per cent, died; of the third twenty-five patients, fourteen, or 56 per cent, recovered, and eleven, or 44 per cent, died; of the fourth twenty-five patients, fifteen, or 60 per cent, recovered, nine, or 36 per cent, died, and the result in one case, or 4 per cent, was not given, and of the last twenty-eight patients, twenty, or 71.43 per cent, recovered, and eight, or 28.57 per cent, died.

Thus as each new group of twenty-five cases has found its way into print, there has been a steady but gradual decline in the mortality rate, namely, from 60 per cent for the first twenty-five cases to 28.57 per cent for the last twenty-eight cases. The same general trend downward of the casualty rate is noticed, but not in as striking a manner, if the percentage of cures and deaths is taken for the first twenty-five cases and at the end of each multiple thereof until the entire series is exhausted; that is, of twenty-five patients, ten, or 40 per cent, recovered, and fifteen, or 60 per cent, died; of fifty patients, twenty-two, or 44 per cent, recovered, and twenty-eight, or 56 per cent, died; of seventy-five patients, thirty-six, or 48 per cent, recovered, and thirty-nine, or 52 per cent, died; of 100 patients, fifty-one, or 51 per cent, recovered, forty-eight, or 48 per cent, died, and in one case, or 1 per cent, the result was not stated; of 128 patients, seventy-one, or 55.46 per cent, recovered, fifty-six, or 43.75 per cent, died, and in one case, or 0.79 per cent, the result was not stated.

Here there has been a reduction in the death rate from 60 per cent for the first twenty-five cases to 43.75 per cent for the run of the series. Today, then, a little more than one of every two patients operated on for pyopericardium by pericardiotomy should recover, whereas a few years ago the proportion was one out of every two and one-half patients. When contrasted with the total collapse of other lines of treatment. these figures in themselves are a sufficient argument in favor of pericardiotomy for purulent pericarditis.

CONCLUSIONS

In concluding, we desire to stress the following points:

1. Purulent pericarditis does not respond to medicinal measures.

2. Therapeutic aspiration is worthless as a curative agent, but may be employed with advantage to tide the patient over a critical period.

3. Pyopericardium is not necessarily a lethal condition, but its cure depends on pericardiotomy with provision for adequate drainage.

4. Operative treatment should yield about 70 per cent of cures.

5. The importance of recognizing an associated empyema, whether primary or secondary, cannot be unduly emphasized, for in the event of such a complication, it is only by incision and drainage of the purulent foci in both the pleura and the pericardium that the recovery of the patient may be hoped for.

6. Postoperative adhesive pericarditis is not so common a complication as is generally supposed.

7. In those patients who recover, longevity is not appreciably compromised.

8. A lessening in the mortality rate apparently depends on earlier diagnosis and earlier operation.

9. The relatively few instances of pericardiotomy for pyopericarditis do not by any means represent the total number of these patients operated on, for many remain unreported; nor are they a true index of the incidence of this lesion, as by far the larger proportion never reaches the hands of the surgeon.

10. The results of pericardiotomy for pyopericardium are necessarily modified by the gravity of the primary disease.

11. In a limited number of cases operation has proved unsuccessful because a coexisting or complicating purulent focus has been overlooked; this oversight is especially likely to occur in the presence of empyema, unless great care is exercised.

12. Autopsy reports show clearly that suppurative pericarditis is much too frequently overlooked by the internist.

BIBLIOGRAPHY

d'Agata, P. R.: Chir. u. Physiol. des Perikards, Arch. f. klin. Chir. **98**:460, 1912. (No patient with suppurative pericarditis operated on.)

Bacon, J. H.: A Procedure for Opening the Pericardium, Am. J. M. Sc. n. s. **130**:652, 1905. (Work done at autopsy, not on the living patient, sternal route.)

Barkan, H., and Lucas, W. P.: Acute Pericarditis in Infancy, Boston M. & S. J. **166**:444, 1912. (Case found at autopsy.)

Batchelor, W. A.: Surgical Treatment of Empyema and Purulent Pericard. Tr. M. Soc. Wisconsin **34**:307, 1900. (No case reported.)

Burtenshaw, J. H.: Paracentesis Pericardii; Report of Case, M. News **74**:289, 1899. (Struck right ventricle. Up to 1896, 100 such cases reported and in only one was the procedure immediately fatal. Sloan [Edinburgh M. J., February, 1895] had this experience but his patient recovered.)

Cassidy, M. A.; Moon, R. O., and Pelly, F. Le Q.: Purulent Pericarditis Simulating Angina Pectoris, Lancet **2**:559, 1921. (No operation. Discovered at autopsy.)

Chavigny et Sencert, L.: Quelques considérations sur la péricardotomie dans le traitement de la péricardite avec épanchement, Rev. méd. de l'est, Nancy **49**:363, 1921. (Bloody exudate; patient considered tuberculous; cured.)

Cottin, E et Gauthier, P.: Purulent Pericarditis Cured by Epigastric Puncture, Arch. d. mal du coeur, Paris **16**:651, 1923. (Five aspirations; 1,655 cc. pus removed [pneumococcal]; no incision.)

Crandon, L. R. G.: Pericardiotomy, U. S. Nav. M. Bull. **13**:299, 1919. (Clear sterile fluid; death from embolism.)

Delorme: Sur la péricardotomie, Bull. et mém. Soc. d. chir. de Paris n. s. **37**:292, 1911. (No patient operated on.)

Desault: Oeuvres chirurgicales de Desault, par Bichat, Paris, 1798, vol. 2, p. 304. (Under diagnosis of suppurative pericarditis undertook to do a pericardiotomy, but the operation revealed an encapsulated pleuritic abscess.)

Doubleday: Case of Suppurative Pericarditis Treated by Aspiration, New York M. J. **48**:232, 1888. (No incision, only aspiration; patient died.)

Durand: De la résection préliminaire du cinquiemè cartilage costal pour aborder le péricarde, Rev. de Chir. Paris **16**:437, 1896. (General discussion.)

Duval, P.; Barasty, H., et Barasty, P.: De la péricardiotomie thoracoabdominale med., Presse méd. **26**:437, 1918. (No patient with suppurative pericarditis operated on.)

Eichel: Die Schussverletzungen des Herzbeutels, Arch. f. klin. Chir. **59**:1, 1899; abstr., Ann. Surg. **30**:658, 1899. (Opposes use of tubes for drainage, stating he had had a case of hemopericardium in which the ends of the tubes impinged on the heart wall and caused a stormy and irregular heart action. Riedel had also had such an experience.)

Ewart, W.: Practical Aids in the Diagnosis of Pericardial Effusion, in Connection with the Question as to Surgical Treatment, Brit. M. J. **1**:717, 1896. (No patient operated on.) The Dorsal Test for Pericardial Effusion, Brit. M. J. **1**:185, 558 and 703, 1897. (No patient operated on.)

Février: Contribution à la chir. du péricarde, paracentèse et péricardotomie, Bull. gén. de thérap. **116**:107 and 169, 1889. (No personal case.)

Fiedler: Jahresb. der Gesellsch. f. Natur- u. Heilk. zu Dresden, 1880, p. 81. (Two cases of aspiration.)

Fowler: Tr. Am. Surg. A. **14**:161, 1896.

Fuchsig: Epigastric Route, in Klose u. Strauss, Arch. f. klin. Chir. **119**:467, 1922.

Gaston, J. McF,: Surgical Treatment of Suppurative Pericarditis, Med. & Surg. Reported, Phila. **76**:686, 1897; Tr. Am. Surg. A. **15**:149, 1897. (No patients operated on.)

Gorse: La ponction doit être absolument rejetée dans tous cas d'epanchement péricardigue, Progrès méd., June 7, 1913, p. 298. (No patients operated on.)

Gould: Case of Recovery from Pyopericardium, Tr. Path. Soc. London (1876-1877) **28**:57, 1877. (Case found at autopsy.)

Heineke: Operation bei Ergussen in der Herzbeutel, Compendium der Chirurgischen Operations- und Verbandlehre, ed. 3, Erlangen, 1884, part 2, p. 567. (No patient operated on.)

Hindenlang, C.: Ein Fall von Paracentesis Pericardii, Deutsches Arch. f. klin. Med. **24**:452, 1879; also Inaug.-Diss., Freiburg, 1879.

Hulke, quoted in West: Brit. M. J. **1**:814, 1883. (Punctured right ventricle when aspirating in a case of adherent pericarditis, with no ill results.)

Hutinel: Péricardite pneumococcique, Pediatrie prat. **7**:200, 1909. (No patient operated on.)

Jaboulay: Péricardotomie, Lyon méd. **91**:389, 1899. (Case of hemorrhagic pericarditis, operation.) La voie xyphoidienne par aborder le péricarde et le cul de sac antérior de la plèvre, Lyon méd. **95**:253, 1900. (No patient with suppurative pericarditis operated on.)

Joannidés: Ueber Pericarditis mit Berücksichtigung der chirurgischen Behandlung der eitrigen Pericarditis, Inaug.-Diss, Berlin, 1902. (No personal case.)

Kissel, A. A.: Sluchaĭ gnoinovo perikardita u malchika 11 lĭet; rariez okoloserdechnovo mĭeska vskrĭtiye (Purulent Pericarditis in a Boy 11 Years Old; Pericardium Opened; Autopsy), Dietsk med., Mosk. **6**:137, 1900. (Patient supposedly tuberculous; Alexandroff, operator; patient died.)

Kleinschmidt, quoted in Klose und Strauss: Epigastric route, M. Klin. **5**:1052, 1909.

Kocher, T.: A Text-Book of Operative Surgery, trans. by Stiles from the German ed. 4, London, A. and C. Black, 1903; Surgery of the Heart and Pericardium, English ed. 2, pp. 170-174. (No patient operated on.)

Koerte: Deutsche med. Wchnschr. **24**:170, 1898.

Larrey: Clin. Chir. **2**:303, 1829-1836.

LeConte: Ann. Surg. **73**:504, 1921.

Locke, E. A.: The Occurrence and Diagnosis of Pericarditis, Boston M. & S. J. **175**:590, 1916. (No patient operated on.)

Loison, Ed.: Des blessures du péricarde et du coeur et leur traitement, Rev. de chir. **19**:49, 205 and 773, 1899; Rev. de chir. **20**:37, 1899. No patient in a personal case of pyopericardium operated on.)

Lozano, R.: Pericarditis purulenta, Clin. mod., Zaragoza **9**:275, 1910. (General discussion.)

Lundmark, R.: Et bidrag till pericarditis kirurgi, Nord. Med. Ark., Stockholm **3**:11, 1911; abstr., Zentralbl. f. Chir. **38**:1622, 1911. (Hemopericardium, knife-wound, cure.)

Lyonnet, B. et Maurice, G.: Péricardite purulente primitive limitée à la partie posterieure du coeur- Deux paracenteses infructueuses, Province méd., Lyon **11**:458, 1897. (Two punctures failed to reveal pus, but 50 ounces found at autopsy.)

Malle: Traité d'anatomie chirurgical et de médecine opérative, Paris, 1855, p. 888. (First to drain pericardium through sternum.)

Manges, M.: Pericardiotomy, M. News, New York **76**:115, 1900. (Of 500 cases of pneumonia at Mt. Sinai Hospital, New York, only eleven patients developed pericarditis, of whom five died.)

Marfan: Ponction du péricarde par l'épigastrie, Gaz. méd. de Paris **74**:357, 1913; Zentralbl. f. Chir. **40**:1844, 1913. (Only epigastric puncture.)

Marinescu, G. u. Cosacescu: Perikardiotomie durch Schwertfortsatzresektion, Zentralorgan f. d. ges. Chir. u. ihre Granzgeb. **14**:25, 1921. (No case reported here.)

Matter, E.: Ueber Pericarditis, Inaug.-Diss., Zurich, 1892. (Two cases found at autopsy.)

Maucuer, L.: De la péricardite purulente, Thèse de Faculté de Méd. et de Phar. de Lyon **13**, 1897-1898.

Meldon, A.: Tr. Roy. Acad. M. Ireland **15**:194, 1897. (No cases of pericardiotomy.)

Meyer, W.: Ann. Surg. **73**:506, 1921. (Pericardiotomy in tuberculous patient, serosanguinolent fluid, with finger in sac no cardiac pulsations felt, but after some fibrinous material was wiped out, heart began beating again. well one year after operation.)

Nobecourte, P.: Les péricardites aigues chez les infants, J. de méd. de Paris **33**:383, 1913. (Operation not performed in a suppurative case.)

Ollier, L.: Traité des resections, Paris **3**:873, 1891. (Excision of fifth costal cartilage.)

Orsini, P.: Un caso di Pericardite Purulenta, Riforma med. **38**:1188, 1922. (Pericardiotomy proposed but patient died before it could be done.)

Paget, S.: Surgery of the Chest, New York, E. B. Treat & Company, 1897. (No personal case.)

Pincoffs, M. C.: Prognosis and Treatment of Pericarditis, Bull. School of Med., University of Maryland, **11**:1, 1926.

Raven: Purulent Pericarditis: Aspiration: Death, Brit. M. J. **1**:1246, 1885. (Incision and drainage recommended, but declined by patient.)

Rehn, L.: Zur Chirurgie des Herzens und Herzbeutels, Arch. f. klin. Chir. **83**:723, 1907; Verhandl. d. deutsch. Gesellsch. f. Chir. **36**:305, 1907; Die Chirurgie des Herzens und des Herzbeutels, Berl. klin. Wchnschr. **50**:241, 1913; Ueber Chirurgie Herzens und des Perikards, München. med. Wchnschr. **59**:1735, 1912; Zur Experimentellen Pathologie des Herzbeutels, Arch. f. klin. Chir. **102**:1, 1913; Ueber perikardiale Verwachsungen, M. Klin. **16**:999, 1920. (No case report of pericardiotomy for pyopericardium, in any of the foregoing.)

Riedinger: Deutsche Chirurgie, Billroth u. Luecke, Stuttg., 1888, pp. 241-245; Verletzungen und chirurgische Erkrankungen des Thorax und seines Inhaltes. (No personal case.)

Roberts, J. B.: The Surgical Treatment of Suppurative Pericarditis, Am. J. M. Sc. n. s. **114**:642, 1897; Tr. Am. Surg. A. **15**:101, 1897; Boston M. & S. J. **36**:522, 1897.

Robison, S.: Surgery of the Heart, Pericardium and Diaphragm, Clifton M. Bull., Clifton Springs, N. Y. **1**:120, 1913. (No case reports of pericardiotomy for pyopericardium.)

Riolanus: Eucheiridion anatomicum pathologicum, 1653, Lib. iii, p. 213 in Hindenlang, Deutsches Arch. f. klin. Med. **24**:452, 1879. (In 1648, advocated tapping the pericardium.)

Romero: Dict. Sc. Méd. **40**:371, 1819. (Three cases of pericardiotomy for serous exudate with 2 recoveries and 1 death.)

Rose: Ueber Herztamponade, Deutsche Ztschr. f. Chir. **20**:329, 1884.

Rotch, T. M.: Absence of Resonance in Right Fifth Intercostal Space, Diagnosis of Pericardial Effusion, Boston M. & S. J. **99**:389 and 421, 1878. (No patient operated on.)

Salomoni: Riforma med. **17**:97-100, 1901. (No case of operation for pyopericardium.)

Schaposnikoff, B. M.: K voprosu o perikardite, etc. (On Pericarditis), Russk. Arch. Patol., Klin. Med. i. Bakterol. St. Petersburg **2**:75, 1896; **4**:80, 1897; Mitt. a. d. Grenzgeb. d. Med. u. Chir. **2**:86, 1897; **9**:485, 1900. (These articles stress the anterior position of the heart in all effusions into the pericardium.)

Schneider: Zur Kasuistik der Pericarditis suppurative, Inaug.-Diss., Halle, 1880. (No patient operated on.)

Sénac: Traité de la structure du coeur., de son action et ses maladies, Paris, 1749, vol. 1, pp. 2-4.

Skielderup, M.: De trepanatione ossis sterni et aperatura pericardii, Acta reg. nona Soc. med. Havn **5**:130, 1818.

Sjovall, S.: Om den kirurgiska behandlingen af exsudationickevariga hjärtsäcksinflammation, Hygiea **5**:464, 1905.

Smith, W. G.: Case of Suppurative Fetid Pericarditis, Paracentesis Pericardii, Practioner London, **5**:386, 1897; in Koch, Inaug.-Diss., Bonn, 1899. (No pericardiotomy, only aspiration.)

Souligoux: Sur la péricardiotomie, Bull. et mém. Soc. de chir., Paris **37**:334, 1911. (No patient operated on.)

Still, G. F.: Brit. M. J. **2**:606, 1901. (No patient operated on.)

Stone: Pericarditis as a Complication in Pneumonia Based on 300 Necropsies, J. A. M. A. **73**:254 (July 26) 1919. (Acute pyopericarditis in 14.5 per cent of 300 patients who had died of pneumonia. No patient operated on.)

Terrier, F. et Reymond, E.: Surgery of the Heart and Pericardium (Chir. du coeur et péricarde) Paris, Baillière et Cie., 1898, p. 98.

Theobald, G.: Ueber eitrige Pericarditis, Inaug-Diss., Goettingen, 1890.

Toubert et Chavigny: Péricardotomie pour péricardite aigue avec epanchement, Bull. de la Soc. méd. des Hôp. de Lyon **11**:189, 1912. (Not purulent.)

Del Vecchio: Sutura del cuore, Riforma med., 1895, p. 78; Brit. M. J., 1895, June 1, epitome, p. 417. (Recommends resection of 2 ribs, fourth and fifth.)

Venus, E.: Die chirurgische Behandlung der Pericarditis, und der chronisch-adhäsiven mediastino-pericarditis (Cardiolysis), Zentralbl. f. d. Grenzgeb. der. Med. u. Chir. **11**:401, 461, 489 and 537, 1908.

Vignalon: Thèse Paris, 1890. (Abstract of Delorme's first case.)

Voinitsch-Sianojensky: La péricardiotomie et ses Bases anatomiques, Rev. de chir. **18**:993, 1898; abstr., Zentralbl. f. Chir. **24**:1271, 1897.

Wehr, V.: Arch. f. klin. Chir. **59**:949, 1899. (No operation for pyopericardium, but advances a new method for opening the chest in injury of the heart and pericardium.)

West, S.: Pericardial Effusion: Its Diagnosis and Treatment, Lancet **1**:560 and 644, 1910. (No patient with pyopericardium operated on.)

Weintraub, W.: Lehrbuch der klinischen Untersuchungsmethoden, Berlin, 1904, vol. 2, part 1, p. 380. (Prefers incision to paracentesis. No report of operation for pyopericardium.)

Widal et Meslay: Péricardite purulente primitive à pneumocoque, Bull. Soc. anat. de Paris 5.s. **9**:603, 1895. (Says case will be published later, but we could find no further reference to it.)

VARICOSE VEINS

ETIOLOGY AND TREATMENT; A CLINICAL AND HISTOLOGIC STUDY *

BERLIN B. NICHOLSON, M.D.
DETROIT

The occurrence of varicose veins in the legs in varying degrees of severity, is much more general and frequent than is usually assumed. Relief is sought only in the more advanced cases, usually those in which considerable incapacitation has occurred. While the patient with a more advanced case may bring his malady to the attention of his physician, the less marked and early case is only observed on careful physical examination, and even then only by the physician who notes the condition of the legs with the patient standing. Yet, it is the early case that offers the most favorable ultimate prognosis. Because of the neglect to note this condition, the case records of even the best conducted clinics are not available in determining the frequency. Even a random estimation would not be of value. General observation leads one to feel that varicose veins are of greater frequency among the laboring population; however, when one considers that the majority of the population belongs to this class, the idea loses its significance, other than to impress the fact that the person least able to bear the inconvenience, even unto incapacitation, is the one on whom the burden is wont to fall.

This latter fact, along with the variation of opinion regarding the underlying cause for varicose veins, has been a constant stimulus to me in carrying out those investigations in which I have been interesting myself for some time. Though the problem must continue to be rather vital, I am at present able to throw some light on certain aspects of it. Many of the difficulties are only too obvious. Perhaps insufficient and inaccurate data have caused the most disagreement among those few who have found some degree of interest in the matter. Strikingly little has been done toward getting at the underlying cause of the disease, and much that has been written is open to considerable criticism. Perhaps, also, the fact that animal experimentation presents difficulties that, at present, seem insurmountable has been an important factor in discouraging serious effort toward investigating the disease; a further hindrance lies in the inherent anatomic difficulty, and, finally, a disease that seldom causes death is slow to arouse the interest of the patient himself, or that of the medical profession, regardless of the degree of incapacitation and suffering it may cause. The great majority are inclined to accept such a disease as an unavoidable evil and one that should be

* From the Department of Surgery of the Henry Ford Hospital.

silently tolerated. Consequently, the meager effort directed toward investigating the cause for varicose veins is traceable both to the inherent difficulties of the problem itself, and to the general attitude of the physician and the patient.

The chief purpose of this paper is to present a study of a series of clinical cases and the results of further histologic investigation regarding the structure of the varicose vein itself. In working with the patients I have been extremely interested in the family history relative to varicose veins The matter of age at which the disease first appears, the sex, the habits, the condition of the cardiovascular system, as a whole, and the distribution and the character of the veins about the legs, as well as other points in the history and the physical examination, have been carefully considered. Some of the results are doubtless of some etiologic and diagnostic value. In addition to reporting the results of my own work, those of other investigators are briefly discussed; and, since the matter of treatment is of considerable moment, it too, is considered.

CLINICAL INVESTIGATION

This study includes 112 cases, of which seventy (62.5 per cent) were in males and forty-two (37.5 per cent) in females. They were unselected in every respect except one: care was taken not to include any case with a definite history of deep circulatory obstruction, and even some with a negative history in this regard were excluded from the series, because they bore many of the signs of an old deep circulatory obstruction. This was done because it is felt that varicose veins resulting from this cause are of entirely different nature. The distribution of the veins and the appearance of the legs are usually different from what is found in the ordinary type of varices, which I have chosen to call "idiopathic." Those resulting from deeper obstruction have their origin on an anatomic basis, which is easily explained and is sufficient in itself; and further, the treatment in these cases must be along entirely different lines from that usually accepted as good treatment for the idiopathic type.

The histories and examinations were all personally conducted, thus eliminating certain elements of individual variation. They were recorded on the history and examination form as indicated. Some of the points relative to which the patients were questioned are doubtless not important and, consequently, do not deserve comment. All patients were examined in the standing posture, the entire extent of both legs being inspected carefully as regards distribution, size, tortuosity and sacculation of the veins. The condition of the great saphenous vein above the level of the knee and the presence or absence of edema, pigmentation and ulceration about the lower leg were also noted. The presence or absence of small superficial bluish veins about the feet and ankles seems

to have considerable significance. They are usually noted only in the advanced case of idiopathic varicose veins, or in those cases in which the varicose veins (frequently small and relatively few in number) are due to some underlying circulatory disturbance other than that produced by the varices themselves. These small superficial veins are conspicuous

HISTORY AND EXAMINATION FORM

Name Salmon, Wallis S. Case No 72342 Service Surg. Date 1/26/1926

Age 34 Sex M Color W Height 69 Inches Wt. 180

Family History Other cases of varicosed veins in the same family. 2 Bro.

(1) Relationship Paternal grandmother Sex F Age of development — Femoral Thrombosis (no)
Number of pregnancies before appearance of varices — After 9 (total)
Occupation Housework Hours on feet long Alcohol 0

(2) Relationship Maternal grandmother Sex F Age of development — Femoral Thrombosis (no)
Number of pregnancies before appearance of varices — After 6 (total)
Occupation Housework Hours on feet long Alcohol 0

(3) Relationship Mother Sex F Age of development 30 Femoral Thrombosis (no)
Number of pregnancies before appearance of varices 5 After 0
Occupation Housework Hours on feet long Alcohol 0

Personal History
Diseases: Rheumatism 0 Tonsillitis + Typhoid 0 Gonorrhea 0 Syphilis 0
Heart trouble (Palpitation 0 (Shortness of breath 0 (Precordial pain 0

Habits and Occupation:
Hours on feet not long Exposures to extremes in weather (much (moderate (none
Occupation Telephone engineer for 10 yrs. (at desk)
Alcohol 0 Coffee 0 Tea 0 Tobacco 0

Present Illness:
Age of appearance of Varices 18 First appeared on left leg right leg at (lower calf (upper calf (thigh
Number of pregnancies before appearance of varices — After —
Symptoms (none (burning (pain and fatigue Ulceration (none (for 12 years Fem.Throm. (yes (no

Physical Examination
Description of Varices: Few small varices over medio-ventral aspect of left calf; also, small varix on dorsum above popliteal area. Occasional small varix on medio-ventral aspect right calf — Slight oedema.
(with patient standing)
Location of Ulcers Over tibia at junction of lower and middle third.
Saphenous above knees (1) palpable Lt. - entire (2) visible Lt. - entire
Hemorrhoids 0 Varicocele 0
Veins on back of pendant hand (markedly, moderately, not) dilated.

Heart Nothing abnormal found.
Blood pressure Systolic, 120; diastolic, 80.
Wassermann (pos., neg.)
Other unusual and pathologic findings Constipation.

about the ankles of persons suffering from deep femoral thrombosis. What is true of this type of small dilated vein is also true of edema. Little or no edema is seen about the ankles of patients who have idiopathic varicose veins, unless the process is marked and extensive, and even then the edema is not of the severe degree often seen in association with deep femoral thrombosis.

Since a rational treatment for the relief of symptoms from varicose veins largely depends on the ability of the surgeon to distinguish the idiopathic type from that produced by various other circulatory disturbances, the general appearance and distribution of the varices were carefully studied and noted in each case. The terms here applied in defining the degree of involvement and areas of distribution are open to considerable criticism, for, at best, they must be quite general. Nevertheless, since all were made by one person, they are open to less criticism than if they had been made by different examiners. In table 1, the number of cases in each group is fairly close, yet the group designated as "moderate involvement" is greatest of the three. Those cases in which the varices were extensive, tortuous and sacculated to varying degrees are placed under the first heading. Those in which the involvement was defined as "moderate" contained many fairly large, tortuous varices, without evidence of sacculation. In each of these groups the great saphenous vein above the level of the knee was usually involved to a greater or less extent. Those cases classed as "slight involvement" had only a few varicose veins, which were only slightly tortuous. The patients were, as a rule, symptom-free, and the condition was noted only on routine physical examination, though occasionally a young woman sought treatment largely for cosmetic reasons. In all cases of idiopathic varicose veins, the distribution about the lower leg appears to be of considerable importance, being almost invariably over the medial aspect of the calf; in other words, it corresponds with the distribution of the tributaries of the great saphenous vein. Involvement of the lateral aspect of the lower leg, unless the case is very advanced, should always arouse suspicion regarding the underlying cause for the varices (figs. 1 and 2). Deep femoral thrombosis, injury, syphilis, diabetes and endarteritis must be carefully ruled out, as, in consequence of the attendant circulatory changes, disastrous operative results may follow the removal of the varices.

TABLE 1.—*Severity of Varicosed Veins*

	No. of Cases	Percentage
Marked involvement	30	26
Moderate involvement	50	44
Slight involvement	32	28

TABLE 2.—*Condition of Great Saphenous Vein Above the Level of the Knee*

	Male		Female	
	No. of Cases	Percentage	No. of Cases	Percentage
Involvement	57	50	13	11
No involvement	13	11	29	25
Right leg alone	10	9	6	5
Left leg alone	14	11	5	5
Both legs	33	30	2	2

From the etiologic standpoint the family history is of extreme interest (table 3). Of the 112 patients, sixty-two (55 per cent) gave a positive family history, and fifty (45 per cent) could not give a definite history, or gave a negative one. These facts seem significant, when one considers that in many instances the patients could not be expected to

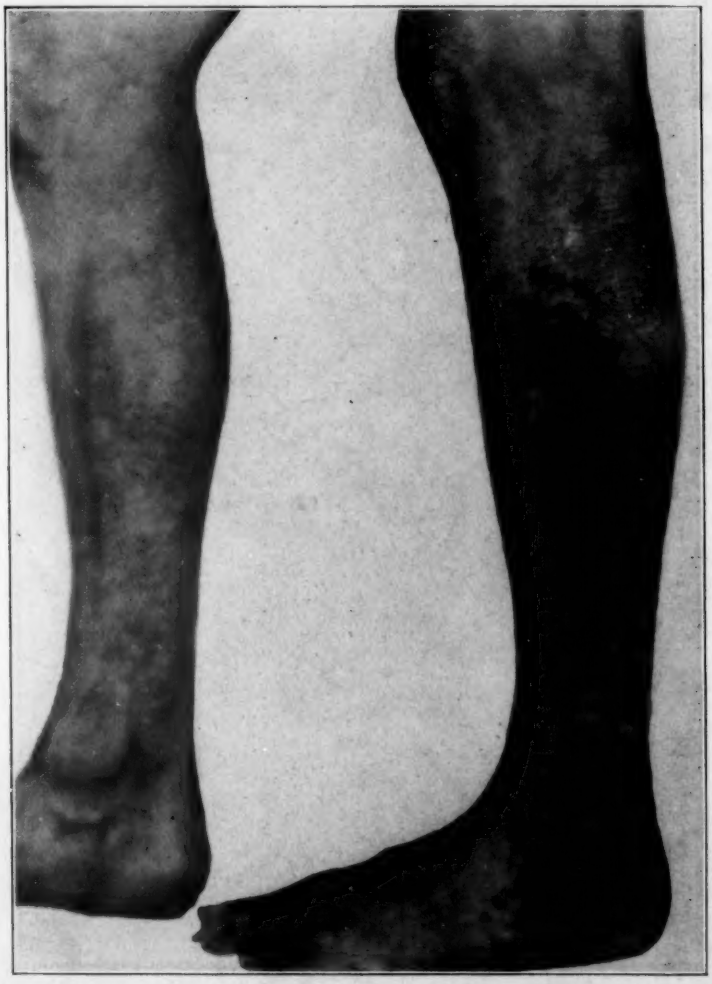

Fig. 1.—Patient with a history of deep femoral thrombosis of left leg, as a complication of influenza pneumonia, nine years previously; small patch of varices on outer aspect of leg, also pigmentation and scarring extending to below the external malleolus should be noted.

know a great deal about the condition of the legs of other members of their family; especially, might this be true of cases in which the varices may have been slight and were not causing symptoms. With due allowance for this, placing the percentage of patients with a positive family

history at seventy-five doubtless would not be excessive. I am confident that heredity is an important factor in the majority of cases. This is further borne out in studying the relationship of pregnancy to varicose veins. Varicose veins in women who have borne children are generally considered to be due to pressure of the gravid uterus on the iliac vessels,

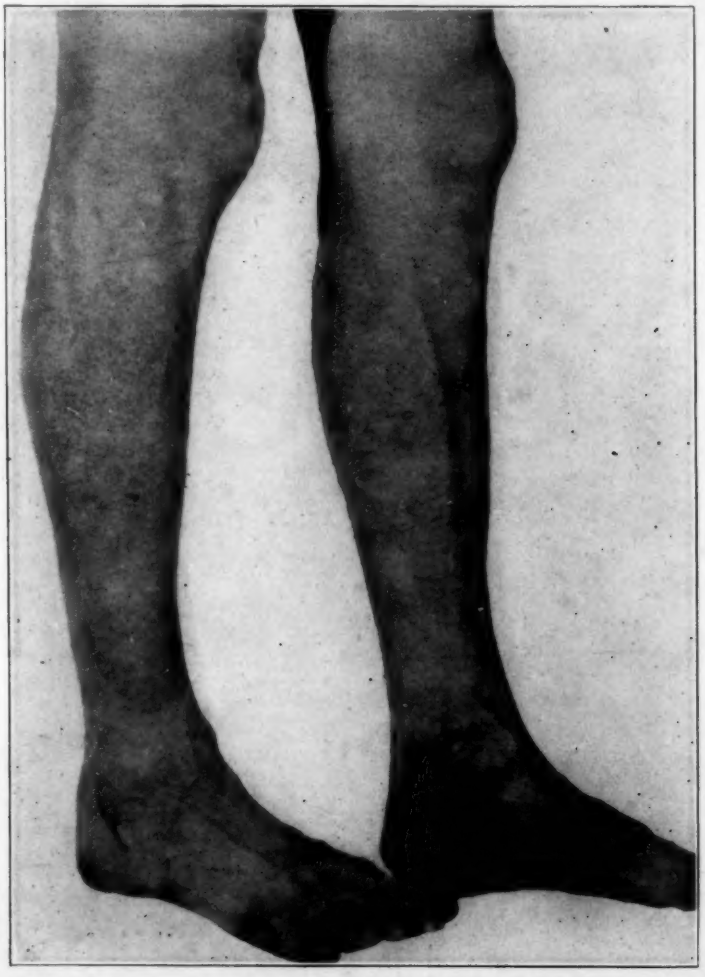

Fig. 2.—Same patient as shown in figure 1; absence of varices along medial surface of leg should be noted; pigmentation and scarring from old ulceration are evident below internal malleolus.

which thus causes sufficient venous obstruction to bring about the dilatation of the veins of the legs. In a previous paper,[1] this was given as one of the more likely causes for varices; however, the results of the present

1. Nicholson, Berlin B.: Histopathology and Etiology of Varicose Veins, Arch. Surg. **7**:47 (July) 1923.

investigation lead me to feel that pregnancy usually plays only a secondary part in the development.

Of the forty-two women in this series of cases, thirty-nine were questioned regarding the relationship between pregnancy and the occurence of the varices. Nineteen (48.7 per cent) had been pregnant before the varices were noted, while twenty (51.3 per cent) had not previously been pregnant.

The age at which the varices were first noticed is of considerable interest and may be of some diagnostic value. The age in each of the 102 cases is recorded in table 4, while in table 5 it is given according to

TABLE 3.—*Relationship of Patient to Other Members of Family Having Varices*

Relationship	No of Cases	Relationship	No. of Cases
Father	11	Sister	19
Mother	37	Aunt	3
Grandfather	0	Uncle	1
Grandmother	4	Nephew	1
Brother	7	Cousin	1

TABLE 4.—*Age at Which Varices First Appeared*

Age	Male	Female	Age	Male	Female
Childhood	2	..	27	2	2
8	..	1	28	2	3
13	1	..	29	..	3
15	2	..	30	3	3
16	2	..	33	1	..
17	..	1	34	1	..
18	9	2	35	1	2
19	1	1	36	2	1
20	6	3	38	1	..
21	..	1	39	1	..
22	3	..	40	5	..
23	5	1	41	1	..
24	1	4	45	2	..
25	8	6	50	1	..
26	2	2	54	..	1
Total				65	37

groups. In the latter it may be noted that the ages of preponderance are 18 (eleven cases), 20 (nine cases) and 25 (fourteen cases). Of the 102 cases, seventy-three (69 per cent) were males and thirty-one (43 per cent) females. The latter percentages are significantly close. The occurrence of varices in males during the fourth decade of life is fairly common; however, beyond this period, idiopathic varices rarely, if ever, occur. In the patients here reported whose age was above 40, there is considerable question regarding the deeper circulation. Therefore, the results are in accord with the generally accepted view, that varices always develop during early life.

The leg first involved and the relative severity of the process in each leg, when both legs are involved, are not without interest. It may be noted, table 6, that in eighty cases (71 per cent) both legs were involved. Of the remaining thirty-two cases, in thirteen (12 per cent)

only the right leg was involved, while in nineteen (17 per cent) only the left leg was involved. It might further be noted that, of the eighty patients with bilateral involvement, fifty-two (65 per cent) were male, while twenty-eight (35 per cent) were female. The greater number being males attracts considerable interest; and several factors may account for this difference. The inference might be that varices are more common in males than in females; this, however, is contrary to the usual view. Further study of the table reveals that the number of cases having the earlier involvement in the right leg equals that having it in the left leg, and that about 60 per cent are males. While all these figures are interesting, they probably have little diagnostic or etiologic value.

TABLE 5.—*Age-Groups of the 102 Cases in Which the Age of Appearance of Varices Could Be Ascertained*

	Male	Female
Early childhood	2	1
10 to 15	4	..
15 to 20	18	7
20 to 25	17	12
25 to 30	9	13
30 to 40	11	3
40 to 50	4	..
— to 54	..	1

TABLE 6.—*Distribution of Varices with Reference to Leg Involved*

	Male		Female		Total	
	No. of Cases	Percentage	No. of Cases	Percentage	No. of Cases	Percentage
Patients with both legs involved	52	46	28	25	80	71
Patients with only right leg involved	8	7	5	5	13	12
Patients with only left leg involved	10	10	9	8	19	17
Right leg involved the earlier	32	30	21	20	53	50
Left leg involved the earlier	32	30	19	20	52	50

The observations relative to the cardiorespiratory system are indicated in tables 7 and 8. Forty-two cases (37 per cent) gave at least one of the three symptoms indicated in the chart, while sixty-nine (62 per cent) were free from symptoms. It may be noted, in table 8, that, of the 112 patients, ninety (80 per cent) were found to be free from symptoms, while twenty-two (20 per cent) revealed the symptoms noted in the table. In this latter group of cases, only about half of the patients had one or more of the symptoms noted in table 7.

The value of the data recorded in both tables is questionable. The symptoms and signs noted are suggestive of cardiorespiratory trouble, but few cases gave frank signs of cardiac disease. Since the conditions noted may have been observed by men not particularly qualified in cardiology, it is doubtful whether the condition of the heart has any appreciable significance. It is, however, conceivable that, should there

be a poor heart action, attended with low pulse pressure and retardation of venous return to the heart, the impairment of the general circulation might have considerable bearing on the etiology of varicose veins. In a certain number of cases, in which there is definite damage to the peripheral vascular area, the relationship is unmistakable, being observed in cases of endarteritis, diabetes and syphilis.

The blood pressure in all cases was recorded. An attempt is made to arrange the readings into groups by multiples of ten. The actual reading was recorded in the chart of each case, but in arranging them, as indicated in table 9, each pressure was recorded in the group which it approached most closely. If the blood pressure has any significance at all, it suggests that it is normal for the age of the group, into which the

TABLE 7.—*Observations Relative to Cardiorespiratory Symptoms in 111 Patients*

	No. of Cases	Percentage
Patients with symptoms	42	37
Patients without symptoms	69	62
Patients with shortness of breath	32	76
Patients with palpitation	27	64
Patients with precordial pain	15	36

TABLE 8.—*Observations Relative to the Heart*

	Male		Female	
	No. of Cases	Percentage	No. of Cases	Percentage
Negative observations	59	65	31	35
Enlargement	6	27	1	4
Systolic murmur	7	32	10	45
Diastolic murmur	..	..	1	4
Extra systole	2	9	..	..
Positive cardiorespiratory history	6	27	6	27
Negative cardiorespiratory history	6	27	4	18

greater majority of the cases fall. The few high pressures were in older patients with varying degrees of cardiovascular damage. Of the 112 cases, sixty-eight (60.8 per cent) had a systolic pressure between 120 and 140 mm. and eighty-seven (78.1 per cent) had a diastolic pressure between 80 and 90 mm.

The height of the patients in inches is indicated in table 10, the majority having a stature ranging between 5 feet 3 inches and 5 feet 9 inches, with a general average of 5 feet 6½ inches.

The data recorded in table 11 may or may not have significance. It might be of interest to compare these results with those of a similar number of unselected cases. This, however, has not yet been done. The most striking fact is that nearly all patients have some degree of dilatation of the veins of the forearm, yet likely this may be true for all people. But, if it is not true, it may be surmised that the dilatation represents an inherent tendency toward varicose veins, or that there is poor filling of the right atrium attended with a certain retardation and

congestion of the venous circulation. These possibilities should be given further consideration.

The symptoms noted and the frequency of their occurrence are indicated in table 12. By comparing this with table 1, it will be noted that 58 per cent of patients having symptoms compares fairly closely with the 70 per cent of patients designated as having marked, or moderate, varicose involvement. This bears out closely the impression obtained during

TABLE 9.—*Blood Pressure*

	Male		Female	
Systolic	No. of Cases	Percentage	No. of Cases	Percentage
100	4	3.5	1	0.9
110	7	6.2	6	5.3
120	13	11.6	8	7.1
130	19	17.0	5	4.4
140	15	13.4	8	7.1
150	5	4.4	5	4.4
160	1	0.9	2	1.8
180	5	4.4	5	4.4
200	..	....	3	2.6
Diastolic				
50	1	0.9	1	0.9
60	3	2.6	2	1.8
70	15	13.4	6	5.3
80	27	24.1	11	9.8
90	20	18.0	8	7.1
100	2	1.8	10	9.0
110	3	2.6	1	0.9
120	..	....	1	0.9
130	..	....	1	0.9

TABLE 10.—*Stature of Patients*

Height in inches	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
Number of cases	1	6	4	10	18	9	12	12	9	12	7	6	2	2	2

TABLE 11.—*Dilatation of the Veins of the Forearm in 99 Cases*

	Male		Female	
	No of Cases	Percentage	No. of Cases	Percentage
Marked dilatation	8	8	1	1
Moderate dilatation	46	46	21	21
No dilatation	7	7	16	16

the course of examining the patients. It was the rarest occurrence to find early cases with symptoms. The most common symptoms were fatigue and burning, each occurring alone or in association with one of the conditions designated in the table.

Table 13 gives the observations relative to three conditions frequently associated with varicose veins. The total number of patients questioned relative to these conditions were: hemorrhoids, 105; varicocele, sixty, and constipation, ninety-four. Only 25 per cent of the patients had hemorrhoids, of which 15 per cent were males. Half of the patients questioned regarding constipation were found to be sufferers

to varying degrees. Of the forty-eight patients, twenty-four were males and twenty-four females. These figures are interesting in themselves, but whether or not they have any bearing on the investigation is problematic. The stasis and the resultant toxic absorption attendant with constipation may have a direct systemic effect, which possibly results in a cardiovascular asthenia and relaxation sufficient to contribute to the process of venous dilatation, ultimately ending in varicose veins. However, since constipation is so common to people in general, it is difficult to carry these considerations to a point beyond the hypothetic.

Of the sixty patients examined for varicocele, twenty-four (40 per cent) were found to have the condition in varying degrees. This is a

TABLE 12.—*Most Common Symptoms*

	No. of Cases	Percentage
Patients without symptoms	47	42
Patients with symptoms	65	58
Fatigue	25	28
Burning	29	25
Cramps	8	7
Itching	5	4
Aching	11	9

TABLE 13.—*Conditions Occurring in Certain Cases*

	Male		Female	
	No of Cases	Percentage	No. of Cases	Percentage
Hemorrhoids	16	15	11	10
No hemorrhoids	47	45	31	30
Varicocele	24	40	..	..
No varicocele	36	60	..	..
Constipation	24	25	24	25
No constipation	32	33	14	15

somewhat high percentage, yet it is doubtful that it carries with it any great significance, other than to suggest that the varicose process may be fairly general for the particular individual.

HISTOLOGIC AND ANATOMIC INVESTIGATION

Elsewhere [1] are reported the results of a study chiefly confined to the finer and gross anatomy of the varicose vein itself. This was based on eight sections taken from four patients, and eighteen gross specimens obtained from cadavers. The microscopic sections were studied carefully for evidence of changes in the smooth muscle, connective tissue and vasa vasorum; the gross specimens, with reference to number and position of valves in the great saphenous, external iliac and upper femoral veins, also, the frequency of anastomoses between the saphenous and the deeper veins.

Since the literature is at variance, as regards the microscopic anatomy of the varicose vein, the level in the saphenous vein from which

the microscopic sections were obtained was carefully noted, for it was felt that much confusion in the picture is due to selection of the tissues at random. This tended to eliminate some of the difficulty in arriving at anything like a definite conclusion; yet, since for each level, the changes noted in a single section might vary from those suggesting the earliest to the latest, the conception of a characteristic picture for each level remained difficult. In fact, the variations in structure noted in each section were so extreme that it was virtually impossible to give a definite description for each level. In almost the same field one might see evidence of hypertrophy and hyperplasia of the muscle cells, along with varying degrees of change in the collagenous and elastic fibers. In the same sections might be seen a greatly thickened area adjacent to one thinned out to a mere membrane (figs. 3 and 4). This variation is due to the irregularity with which the vein has dilated. The thin areas represent the walls of sacculations; and, it is at these points, in advanced

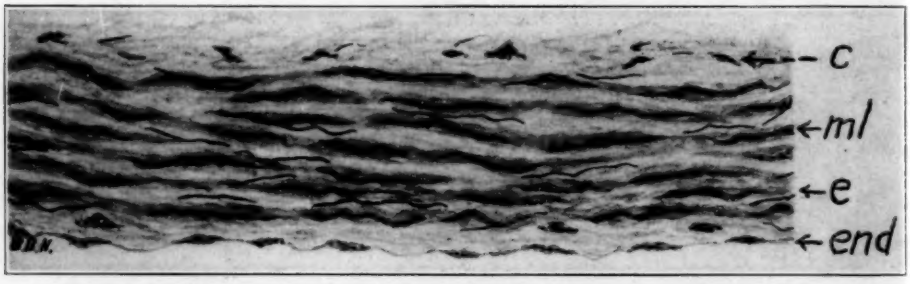

Fig. 3.—Transverse section of membranous portion of varix above level of knee; *ml* indicates wavy, unhealthy and attenuated, smooth muscle cells containing densely staining, elongated nuclei of irregular outline; *c*, connective tissue cell; *e*, elastic fiber; *end*, endothelium; × 400.

varicose disease, that the vein may rupture upon the slightest provocation. Besides this variation in the picture for each level there is a still greater variation for different levels, the more marked degenerative changes being noted below the knee where the hemostatic pressure is greater.

The intima of the great saphenous vein near its opening into the femoral is thickened in areas and contains a considerale amount of smooth muscle longitudinally disposed. In this layer, one may clearly distinguished the nuclei of muscle cells in all stages of amitotic division. This was invariably noted in the thickened areas, in which the muscle cells were much more numerous than in the normal ones. The media at this level is by far the thickest coat and is composed of circularly disposed muscle embedded in connective tissue. There is a distinct internal elastic membrane and a less marked external elastic network. Both of these are composed of coarse elastic fibers, arranged more or less longi-

tudinally. The adventitia here is somewhat less thick than the media and is composed largely of connective tissue in which there are many elastic fibers. At intervals, longitudinally disposed smooth muscle may be seen. The striking feature at this level is the relatively healthy appearance of the tissue and the lack of thin areas in the venous wall.

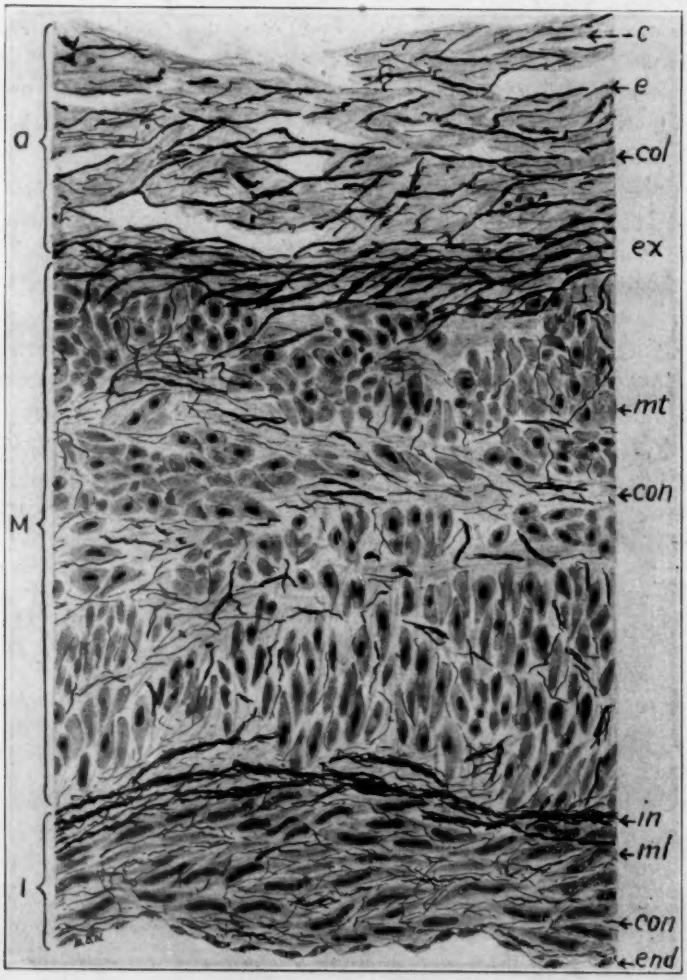

Fig. 4.—Segment of transverse section of varicosed saphenous vein above internal malleolus; *A* indicates adventitia; *M*, media; *I*, intima; thickening internal to internal elastic membrane is evident; *con*, indicates connective tissue; *col*, collagenous fiber bundle; *c*, connective tissue cell; *e*, elastic fiber; *ex*, external elastic network; *end*, endothelium; *in*, internal elastic membrane; *ml*, muscle in longitudinal section; *mt*, muscle in transverse section; × 266.

More distal to the saphenous opening, there is a less healthy appearance to the muscle, a greater amount of connective tissue, a less marked and a less complete internal elastic membrane and perhaps a more gen-

eral thickening of the intima, which may be either internal or external to the internal elastic membrane. Near the middle of the calf of the leg the longitudinal muscle in the adventitia may or may not be found, and at a level above the internal malleolus it is never found. The most striking feature noted in sections taken from immediately above the internal malleolus is the reversal in the disposition of the tissue layers found in the media. Instead of the muscle being circularly arranged it takes a longitudinal course. Likewise, the elastic fibers in the elastic layers and the collagenous fibers in the adventitia are, for the most part, circularly arranged. It might also be further noted that muscle cannot be found in the intima at this distant level in the leg.

The study of the eighteen gross specimens revealed that, in each case, save one, a pair of valves occurred in the external iliac vein, about 3 cm. above the saphenous opening. Six veins had a second pair of valves, from 7 to 10 cm, above the saphenous opening. In every specimen there was a pair of valves guarding the saphenous opening, and about 2.5 cm. below the opening, a second pair could be constantly found. Below these, there was not any regularity of arrangement. The most significant fact, however, regarding the valves in the saphenous vein, below its opening into the femoral vein, was the regularity with which they guarded the orifice of the branches opening into the saphenous vein. Almost without exception, there was a pair of valves just within the mouth of the entering branch; and in those few instances in which this was not true, a pair of valves was found in the saphenous vein immediately below the orifice of the entering branch, which amounts to having them in the mouth of the vein itself.

Various authors have suggested that in certain cases of varicose veins there might be a trophic process involved in bringing about the diseased condition. So, for some time, I have been interested in studying the nerve distribution of the normal and the varicosed vein. In this investigation the varicosed veins from four operative cases were utilized. Sections from various levels in the leg were chosen. These were treated by the gold chloride technic after the method described by Jordan.[2] Several variations in the application of the technic were carried out, with varying degrees of success. Best results were obtained when small pieces of freshly removed tissue were used and treated for twenty minutes in freshly filtered lemon juice. These were hurriedly washed in distilled water and placed in the dark for one hour in a freshly prepared 1 per cent gold chloride solution. They were again hurriedly washed in distilled water and placed in the dark for forty-eight hours in a 25 per cent aqueous solution of formic acid. After this, they were washed, dehydrated, embedded in paraffin and sectioned. Some of the

2. Jordan, Harvey E.: A Text-Book of Histology, New York, D. Appleton & Co.

sections were counterstained lightly with hematoxylin and eosin, but this was of little or no value, for the morphology of the tissue is not sufficiently preserved by the method to be brought out, as it is after being treated in the ordinary fixing agents.

The normal veins studied were taken from two recently amputated legs. One was the left leg of a man, aged 34, amputated because of a severe crushing injury to the upper thigh; the other was the right leg of a girl, aged 16, amputated because of a sarcoma of the lower thigh. Both gave histories and evidence of a normal venous circulation. The tissues were removed within an hour after amputation and treated after the technic noted previously.

The tissues from two of the varicose vein cases were so poorly stained that the nerve terminals were inadequately defined. All of the others were sufficiently satisfactory to be used in this study. In some

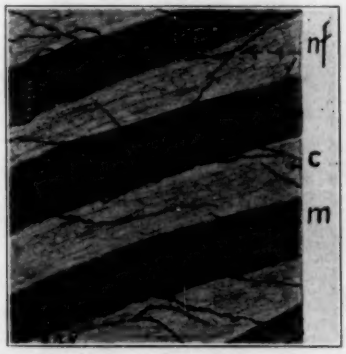

Fig. 5.—Section of media of saphenous vein, showing: *nf*, nerve fibrils, terminating in association with smooth muscle, *m*; *c*, intervening connective tissue; × 1,000; gold chloride technic.

of them the nerve fibrils were beautifully shown (fig. 5). They appeared as delicate, dark, slightly tortuous and branching fibers, distributed to the muscle bundles. Their appearance was not unlike those described by Larsell [3] in the wall of bronchial blood vessels. The knot-like dilatation described by him along the fibrils were not clearly defined. Though there was more or less irregularity in the fibrils, this was in all probability due to irregular deposition of the gold salt. The character and distribution of the fibrils did not seem to vary, there apparently being as many to the muscle of the varicose vein as to that of the normal vein. In addition to the terminal fibrils themselves, many small nerve branches were seen all through the adventitia and outer portion of the media (fig. 6).

3. Larsell, O.: Nerve Terminations in the Lung of the Rabbit, J. Comp. Neurol. **33**:105 (June) 1921.

During the course of these studies part of the tissue was fixed in formaldehyde and stained with hematoxylin and eosin. In studying these, the most outstanding feature noted was the unhealthy appearance of the muscle in the media of the varicose vein, as compared with that found in the same layer of normal veins. In the pathologic material, the cells were somewhat attenuated and the nuclei elongated, pyknotic and more deeply staining than those found in the normal tissue. The characteristic light staining area surrounding the nuclei of normal smooth muscle cells was virtually absent about the nuclei of those found in the varicose vein (fig. 7). These results further support the idea

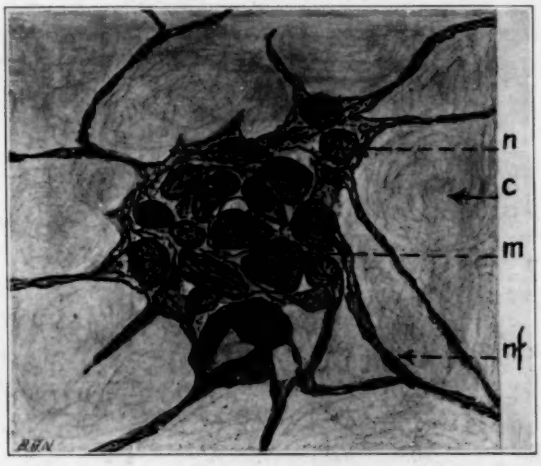

Fig. 6.—Small nerve trunk found in adventitia of normal saphenous vein; *n* indicates non-medullated fiber; *m*, medullated fiber; *nf*, nerve fibril; *c*, connective tissue; × 1,000; gold chloride technic.

that the underlying process in the formation of varicose veins is degenerative, though the factor bringing it about may vary under different circumstances.

TREATMENT

The treatment for varicose veins may be directed along three different courses, depending on the extent of involvement and the underlying cause. It may be prophylactic, supportive or surgical, or even a combination of the three. Regardless of the procedure followed, the result in many cases is far from gratifying, and in some it may be disappointing. When the disease is early and the involvement of the veins slight, treatment should be directed toward preventing further damage. This is best accomplished by having the patient work at an occupation which will keep him off his feet, at least part of the time. Many think that standing for long hours, without being able to walk about, promotes the

establishment of varices. Though this contention is not supported by statistics, there may be some basis for it. Considering the physiologic and anatomic factors relating to the circulation of the legs, it is easy to understand that the massaging and pumping action of muscles, brought into play during locomotion, might improve the circulation sufficiently to keep the musculature of the venous wall in such a state of nutrition and tone, as to prevent the veins from becoming dilated.

Some hold that the anatomic relationship between the vein and the fascia surrounding it, as the former turns inward to enter the femoral vein, is in many cases largely responsible. This, too, lacks conclusive

Fig. 7.—Comparative drawings of muscle found in media of varicosed (*A*) and normal (*B*) saphenous vein; in *A*, the nuclei are elongated and pyknotic, whereas in *B*, a more normal appearance is observed, the muscle cells being larger and the nuclei being surrounded by the characteristic clear zone; × 1,000; hematoxylin and eosin technic.

proof, but deserves careful consideration and further study. Turner,[4] who is strongly inclined to this view, gives a clear description of the anatomic structures involved.

The hiatus in the fascial sheath of the thigh is bounded on the outer side by the iliac portion of the fascia lata, which has a sharp, well-defined edge known as the falciform border. The upper portion of this, known as the superior cornu, turns inward superficially to the femoral sheath to join Poupart's Ligament. The lower portion, known as the inferior cornu, curves inward, deep to the termination of the internal saphenous vein but superficial to

4. Turner, P.; Etiology and Treatment of Varicose Veins, Guy's Hosp. Rep. **73**:225-232 (April) 1923.

the femoral sheath, to become continuous with the pubic portion of the fascia lata which covers the pectineus and adductor longus muscles and is attached to the ilio-pectineal line of the pubis. Though there is no sharp alteration in direction, the internal saphenous vein here crosses the well-defined inferior cornu of the falciform edge and joins the femoral vein on a deeper plane, the sharp fascial margin intervening between the two vessels This arrangement by no means necessarily causes obstruction, but it is a relationship where some additional factor may easily produce a slight but definite degree of obstruction which, acting continuously or intermittently over a long period, may produce far-reaching results. The additional factor is, I suggest, increase in the tension of fascia lata. In the sitting or recumbent position the fascia lata is relaxed.

This same author suggests that the relationship between the saphenous vein and the opening of the superficial epigastric, the superficial circumflex iliac and the external pudic vein may, in certain cases, be a contributing factor toward the development of varicose veins. Since the direction of the flow of blood in these veins is downward, and more or less in direct opposition to the current in the saphenous vein, it may be responsible for certain retarding effects on the saphenous circulation. But, if this were true, one might expect to see the first effects in the upper saphenous vein near the point at which these branches enter. Yet it is only a matter of common observation that the upper portion of the saphenous vein rarely becomes varicosed until relatively late in the course of the disease. While the relationship between the upper end of the saphenous and the fascia, and that between the vein and the entering branches, are worthy of consideration, both lack anatomic and physiologic support.

In the early case, accordingly, treatment should be directed toward preventing further increase in the varicose process. Aside from favoring the legs posturally, too strenuous exercise should be forbidden, for a few patients give histories suggesting a definite relationship between vigorous athletics and the occurrence of the varices. In the moderately advanced case there may be some question regarding the preferable treatment. In the majority, external elastic support should first be tried. While it cannot be expected to eliminate the varices it may give considerable relief from symptoms, if there are any, and also prevent the veins from further dilatation. The great difficulty with its application is in getting the patient to carry out the measure faithfully. The wide knit bandage reapplied each morning is the most effective. They are least costly and easily kept clean, though more or less bothersome to apply, and, to women, they are unsightly. Elastic stockings are more readily applied and do not appear so conspicuous through silk stockings, but, at best, are unsatisfactory. Often they do not fit properly from the first, and usually can be worn only a short time without becoming, to a greater or less degree, ineffective. Furthermore, during the hot summer months, patients often complain considerably of the added heat, and frequently of excoriation which also adds to the discomfort.

The more advanced case of varicose veins and certain of the less advanced ones are most satisfactorily treated with surgery. Though surgical treatment is at best often disappointing, it is thus far the most satisfactory method known for those cases in which the veins are tortuous, thin-walled and sacculated, with probably an overlying pigmented, unhealthy skin. In a number of such cases, there may be such a poor state of nutrition of the tissues as to have caused ulceration. The symptoms too may be distressing and, therefore, may constitute a further cause for demanding the more radical treatment. As a matter of fact, when the disease seems to be progressive, surgical treatment is sometimes justifiable for the purpose of preventing these late and advanced trophic changes, which are not readily relieved after they have once become established. Prior to attempting surgery, an effort should be made to cure any ulceration that may be present. When this is impossible, the sore should be made as free from infection as possible, and at operation sealed off from the operative field. The average ulcer responds readily to the treatment usually advocated, but it is of paramount importance to keep the patient off his feet, even to the extent of his remaining absolutely in bed.

Before attempting to remove the varices, one should make a careful study of each case to determine the extent of the deep collateral circulation. If this is not done, grief is certain eventually to befall the surgeon. Of prime importance is a careful history to rule out deep femoral thrombosis, which may have resulted in obstruction to the deeper venous circulation. Varices coming on after an injury to the leg or pelvis, or even after an illness, though definite history of deep femoral thrombosis cannot be ascertained, must be looked on with great suspicion. It is not uncommon, during the convalescence of a patient, to have a slow, progressive obstruction of the deeper veins, without the classic symptoms and signs of deep femoral thrombosis ever occurring. The absence of symptoms from deep femoral thrombosis is frequently impressed on us, when a sudden fatality from pulmonary embolism occurs following an otherwise simple operation. Frequently the only suggestion of impaired circulation is manifested in the form of undue and prolonged asthenia of the legs, possibly attended with slightly painful sensations.

Furthermore, certain of the systemic diseases must be ruled out. Not infrequently, as a complication of syphilis, diabetes and certain cases of endarteritis, changes take place in the circulatory function of the legs which produce a condition that may easily lead one astray. Attending these circulatory changes varices almost invariably make their appearance; but they usually are not extensive, occur relatively later in life than do idiopathic varices and have a more or less characteristic distribution over the leg. The veins involved may be located anywhere

over the lower leg, which frequently is brawny, indurated, edematous and pigmented, and may bear one or more indolent ulcers. Careful questioning will often bring out the fact that the varices appear relatively late with reference to the disease process involving the leg. Even the ulceration itself may appear before, or about the same time, the varices occur. The great saphenous vein above the knee is rarely dilated to the extent of being even palpable. I feel that in many, if not all, of these cases the underlying factor is impaired nutrition of the legs, resulting from some degree of circulatory failure, perhaps most often an endarteritis. The varices represent only another manifestation of failing circulation, rather than being responsible for the failure. The mechanism is probably simple in these cases; as the nutrition of the vessel musculature fails, it fatigues more easily, and, being unable to bear up under the increasing strain, it gradually dilates. This influence, of course, is at work in all types of varices; for, as the varices develop and the circulation becomes less effectual, a vicious cycle is sooner or later established. In the counteraction of this influence lies the only rationale for the use of elastic bandages, stockings and the like.

The treatment in those cases in which the varices depend on some obstruction or impairment of the deeper circulation must be more or less palliative. Any systemic disease must be treated, and if there are ulcers, they must be treated in the usual manner with local applications and by keeping the patient off his feet as far as possible. Even when all of the measures at one's disposal are carried out, the ulcer often cannot be healed. Such ulcers, too, respond poorly to operation. Surgery should be undertaken advisedly and the patient should be fully informed beforehand as regards the likelihood of failure. In some cases the ulceration may be so extensive and the symptoms so severe as to justify amputation. I think, however, that this is not often necessary, though I have seen it so in one instance.

Elastic bandages and stockings in these cases are not well tolerated and lend themselves poorly to the treatment. Usually the venous bed is so poor that any constriction of it increases the symptoms to such a degree that the support cannot be tolerated. As a test for determining the patency of the deeper venous circulation in such cases, the application of a bandage to the lower leg has been advocated. It is doubtful, however, whether this measure is applicable as a differential test in distinguishing between idiopathic varices and those of other origin; yet the test may be of value in determining the volume of the venous circulatory system, regardless of whether it is deep or superficial, or both. Beyond this application, after a consideration of the mechanical and physical factors involved in the procedure, the bandaging is of doubtful value. The test is applied by bandaging the leg snugly from the foot to the knee and then allowing the patient to walk continuously for

thirty minutes, or until definite painful symptoms develop. In some cases in which the venous circulation is relatively poor, the bandage is tolerated only a short while. If the evidence points to a scant venous circulation, regardless of cause, operation is contraindicated.

The nature of the surgical treatment of those patients who seem to be fit subjects for operation deserves serious consideration. At the outset, it should be understood that removal of the veins is in many cases unsatisfactory to a greater or less degree. The very nature of the procedure itself makes this true. Because of this, various attempts have been made to avoid some of the difficulties. These have been largely in the direction of varying the method and procedure by which the veins are removed, or their lumen obliterated. Regardless of the method selected, it is more time-consuming than it is difficult.

The usual and most accepted method is excision. However, before any operative procedure is attempted the patient should be examined while standing and the varices should be marked with silver nitrate, or one of the aniline dyes that will not be effaced by the regular surgical preparation of the leg. In the usual case, it is preferable to excise a considerable portion of the saphenous vein above the knee. If this is not done, the varices are likely to recur. One may accomplish the removal by making an incision over the entire length of the leg, but better by making small incisions at intervals along the course of the vein, incising it, passing a probe up its lumen, securing the vein to the probe at the point of the adjacent incision and stripping out the vein through traction on the probe. This lessens the extent of scarring and facilitates healing. The varices of the lower leg are probably best removed through longitudinal incisions made over the most prominent masses. If the incisions are made in this manner, the distribution of the cutaneous nerves is not interfered with to any appreciable extent. The classic Schade operation, in which the entire circumference of the leg is incised, no longer commends itself. Even the modified Schade operation, in which the incision extends only part way around the leg, is probably less satisfactory than that in which the incisions are made in a longitudinal direction over the masses of varices. If an open ulcer is present, its excision or incision may promote its healing.

In treating patients with varicose ulcers, Smits [5] advocates nerve stretching, or teasing. He applied his technic to the internal saphenous, the external popliteal, the external saphenous and, sometimes, the sciatic nerve. He seems to think that the stretching improves not only the ulcer, but also the trophic condition of the vessel wall. If the ulcer is large, he either curets it, or does an excision followed with a skin graft. He reports eighteen cases, claiming a cure in all. But,

5. Smits, J. C. J. C.: Varicose Ulcers, Ann. Surg. **63**:561 (May) 1916.

since some form of operation for the ulcer was done and, in some cases, even the varices were removed or the saphenous vein was ligated, all of which procedures are the usual ones and carry with them a convalescent period in bed, there remains considerable room for doubt regarding the real value of the nerve stretching operation. To give it credit for the healing of the ulcer seems unfair, when rest in bed alone will bring about healing in the majority of ordinary varicose ulcers.

With the idea of eliminating scar-formation, so far as possible, Keller [6] has described a method of obliterating the lumen of the varix with a continuous silk suture applied subcutaneously. He first strips out the less tortuous portions of the saphenous through small incisions made along the course of the vessel. The more tortuous portions, which are not amenable to this method, are ligated in segments of from 4 to 5 inches (10.1 to 12.7 cm.) and the lumen of the segment is obliterated by continuous subcutaneous silk sutures which are passed through the vessel wall in such a manner that the latter becomes collapsed, when the sutures are drawn tight and tied. These are left in place for ten days, at the end of which time the lumen has become obliterated through an organized thrombus.

A further method of treating varices without performing an open operation is through injecting the lumen with some substance that produces a thrombus, which subsequently organizes, thus obliterating the lumen. Hitherto, the mere suggestion of such a method would be sufficient to throw discredit on the whole procedure. However, when the short-comings and disadvantages of the ordinary open operation are considered, any method that is logical and promises something better should not be condemned without careful consideration. The thing most feared in the application of the injection method is dislodgement of a thrombus, with a resultant embolus. Yet, it may be that this danger has been too seriously considered. It should not be forgotten that a fatal embolus not infrequently follows the operative removal of varices. Experimental studies of the injection method will be undertaken in laboratory animals.

This method has been carried out by Douthwaite [7] in eighty-eight cases, in which over 1,000 injections were made. He has used it for two years, seemingly having complete success, and without recurrences.

"The solution used is composed of quinine hydrochloride, 4 Gm., urethane, 2 Gm., in distilled water, 30 cc. A pneumatic tourniquet is applied with moderate pressure above the line of the vein to be dealt with and 0.5 cc. of solution injected into the lumen through a fine

---

6. Keller, Wm. L.: Combined Extirpation and Obliteration in the Treatment of Varicose Veins, Ann. Surg. **79**:907-912 (June) 1924.

7. Douthwaite, A. H.: The Treatment of Varicose Veins by Injection, Brit. M. J. **2**:554 (Sept. 25) 1926.

hypodermic needle. Perivenous administration is usually unnecessary; it is not, however, contra-indicated, as the resultant inflammation is not severe, provided only a few minims are injected outside the vein. The puncture is sealed with collodion, which may be removed the same night, and the injection repeated about two inches further up the vein. It is wiser not to introduce more than 2 cc. at one sitting."

The amount of pain varies considerably, but is usually not severe enough to prevent walking. All patients went to the consulting room "and returned home in their usual manner." "Initial swelling of the vein is not uncommon, but this soon subsides, and after a few weeks it may be felt as a nodular cord, causing no bulging on the surface of the leg, unless it be situated over the subcutaneous surface of the tibia."

Other injecting agents have been used with considerable success; some, however, seem to cause severe pain for about one minute after the injection. Dunbar [8] has treated thirty cases, mostly with injections of sodium salicylate. When the salicylate is used, care must be taken to test the patient for an idiosyncrasy. Mercury perchloride (1-500) was also used and found to be somewhat less painful.

COMMENT

Though I have only begun to clarify certain aspects of the problem relative to the etiology and treatment of varicose veins, I shall feel well repaid for my efforts, should they be of some avail in stimulating others to further researches. As has been suggested, studies in this subject should be as carefully controlled, and as painstakingly worked out, as those in any other disease. Yet, this has not been the case. Few have taken the matter seriously. Several have advanced theories regarding the cause, while many are indiscriminatingly removing all varices. The immediate results in many cases are fairly satisfactory, while in not a few they are quite the opposite.

The treatment may in all probability remain practically the same, yet there is much to be desired as regards the differentiation between the operative and nonoperative case. In the former the results obtained from removing, or obliterating, the varices may be expected to give the patient considerable comfort, while in the latter the results are doomed from the start, and the patient, to say the least, is not benefited and, in some instances, may even be made worse. In selecting a case for operation, one must constantly remind himself of the possibilities for making the patient a hopeless cripple. As most people so affected depend largely on their legs in the performance of their occupation, the ultimate result must not be considered lightly.

---

8. Dunbar, J.: Treatment of Varicose Veins of the Legs by Injections, Brit. M. J. **1**:14 (Jan. 3) 1925.

Since, also, there is considerable evidence suggesting that heredity and a constant standing posture play an important rôle in the development of varices, much in prophylactic measures might be accomplished. Those who have early varices should be urged to stay off their feet, so far as possible. This is doubly true for those who know of other cases of the disease in their family, regardless of the relationship between its occurrence and any pregnancies that the sufferer may have passed through; for many women have several children without having varicose veins. And, since the majority have the varices occurring before the age of thirty, the condition should be watched for in early youth. Yet, treatment in the early case can seldom be accomplished. In the future, however, much may be done through education.

Though, in the large majority of cases, the hereditary factor seems to play an important rôle, likely other factors are immediately responsible for the primary dilatation. It is not improbable that, in the instance of some veins having a characteristic anatomy, various toxic substances and debilitating conditions may be sufficient to initiate the dilatation of the vessel wall. Since the normal function of a vessel is directly dependent on the tone of its musculature, any substance or condition that might produce fatigue might also, after some time, result in dilatation. After the dilatation is once begun, various influences tend to promote its increase.

Early in the process, the valves along the course of the vein become incompetent to varying degrees. Nevertheless, contrary to the usual conception of their function, they act only in directing the current of venous blood toward the heart, and not in the actual lifting of it to that organ. The static pressure in the vein exerted by a column of blood, the upper limit of which extends to the level of the heart, is the same, regardless of the condition of the valves. Granting that the average length of this column is 1 meter and that the average arterial pressure is 110 mm. of mercury, the pressure on the venous wall near the level of the ankle would be 100 Gm. per square centimeter, as compared with an arterial pressure of 148.5 Gm. When one considers what ordinarily happens to a vein after the arterial stream is turned into it, the dilatation of the veins of the leg subjected to this pressure, which is equivalent to two thirds that sustained by an artery, should not cause great surprise.

It has been explained elsewhere [1] that, were it not for the siphonic action of the column of blood extending from near the level of the elbow to the opening into the right atrium of the superior vena cava, varices of the hands and arms might be encountered more frequently. As it is, however, the static pressure in the hands, even when in their most dependent position, is insignificant.

The motive forces responsible for the venous circulation of the legs are three in number. The most important is the arterial pressure

transmitted through the capillaries into the venules and veins. A slight negative pressure created in the inferior vena cava through the respiratory excursions of the chest wall, and a pumping action resulting from contraction and relaxation of the muscle groups of the legs, play some part in lifting the blood through the veins of the leg. The negative respiratory pressure is slight, and can for all practical considerations be neglected. Though the pumping action of the muscles is important, it alone could not maintain the circulation. All is dependent on the arterial pressure exerted by the ventricles of the heart. The pumping action of the leg muscles becomes effective only when the blood has been driven into the lower venous branches by the arterial pressure, thus placing it above some of the lower valves. In connection with this action of the muscles, the valves serve one of their most important functions. Owing to their presence the blood is not forced downward. In case of an absence of valves, the muscles would actually hinder circulation rather than aid it. As it is, however, the moment the pressure exerted on the vessel wall by the contracting muscles exceeds that exerted by the arterial pressure, the valves, below the point at which the muscles are acting, close and the muscular pressure forces the blood to a higher level. During the short interval that the valves below the contracting muscles are closed, the weight of the column of blood above is taken off the vessel wall; only during the interval can this be true, and even then the vessel wall is not relieved of its load, for the transmitted arterial pressure in the vein, distal to the point influenced by muscular force, must be greater than the static pressure normally exerted by the column of blood in the upper portion of the saphenous vein. Therefore, it is evident that the valves in the veins can never function in relieving the venous wall of static pressure, for, in order to get the blood into the heart, the transmitted arterial pressure must lift a column of blood extending from a level in the foot to the opening of the inferior vena cava, and, so long as there is any flow toward the heart, the valves of necessity must be open along the entire length of the blood stream. When the valve flaps are thrown back, they cannot afford any support to the column of blood above.

A further function of the valves is that of directing the blood toward the heart. As brought out previously, each branch entering a larger vessel has its orifice guarded by a pair of valves. Were it not for these, the blood in the main channels might be forced through the branches and anastomoses, thus imposing some degree of delay in reaching the heart. This might especially be true during muscular activity, when the pressure from the contracting muscles is exerted equally in all directions. If, for any reason, the valves should become incompetent, the blood would be greatly retarded in reaching the heart, for it would tend to flow back through smaller branches and anastomoses.

Furthermore, the pumping action of the muscles would be lost, or might even become an adjunct to the morbid process. Those branches unprotected by valves would receive much of the blood which, under normal conditions, would be forced to the heart. Under such circumstances, there would be a more or less vicious cycle set up in the veins of the legs; and though, according to Zancani [9] and others, the prolonged contact of the impure blood with the venous wall might be productive of certain damage, the most deleterious effect, no doubt, is the entailed impairment of nutrition to the tissues. The dilatation and changes found in the vein, therefore, only represent a portion of a nutritional deficiency common to all the tissues of the leg. In the early stages of the disease, this impairment is relatively slight; however, with further dilatation and establishment of incompetence of the valves, the circulation becomes less effective, and, eventually, a more or less vicious cycle is established. When this stage has been reached, little can be expected from a treatment that is not directed at improving the venous return to the heart.

CONCLUSIONS

1. In my series of 112 cases, the number was fairly equally divided between males and females.

2. Pregnancy usually is not a cause for varices, though in certain persons it may have an important secondary influence.

3. Sixty-nine per cent of 102 patients developed varicose veins between the ages of 18 and 30.

4. Among 105 patients questioned regarding the leg first involved, the percentage for the right leg virtually equaled that for the left.

5. Study of the nerve terminals in the venous wall indicates that varices are not ordinarily trophic in origin.

6. The opening of the saphenous vein is always protected by two or more pairs of valves.

7. All tributaries entering the saphenous vein are protected with a pair of valves.

8. The valves act only in directing the blood stream toward the heart, and not in protecting the venous wall from static pressure.

9. In the majority of cases, heredity seems to play an important rôle in the development of varices.

10. The later stages and manifestations of varices represent the results of a combination of deleterious influences.

11. Treatment may often be difficult and unsatisfactory.

12. Great care should be taken in selecting cases for operation.

---

9. Zancani, A.: Ueber die Varicen der unteren Extremitäten, experimetelle und Klinische Untersuchungen, Arch. f. klin. Chir. **96**:91, 1911.

ROENTGEN-RAY TREATMENT OF TUBERCULOUS CERVICAL LYMPH GLANDS

A STUDY OF ONE HUNDRED AND FORTY-ONE PATIENTS TREATED BY SMALL DOSES OF FILTERED ROENTGEN RAY, WITH FOLLOW-UP RESULTS *

JOHN MUNN HANFORD, M.D.
NEW YORK

Roentgen discovered the "X" or unknown rays at Würzberg in 1895. The active or chemical powers of the rays were first recognized through the destructive burns received by the numerous new experimenters. The burns at once suggested the possibility of a new agent for the destruction of morbid tissues, notably those of the skin, including tuberculosis.

In 1902, Dawson Turner,[1] medical head of the electrical department of the Royal Infirmary, Edinburgh, published the third edition of his "Manual of Practical Medical Electricity." On page 376, under the subheading, "Enlarged Tubercular Glands," he writes:

> "Six cases of enlarged tubercular glands have been under roentgen-ray treatment in the Electrical Department of the Royal Infirmary. The exposures have been of five minutes duration, three times a week. The duration of the disease has varied from thirteen years to three months. In some of the older cases, many operations had been performed and sinuses were present. The glands affected were cervical in five cases and axillary in one. In all these cases, marked improvement has been brought about, and in two of them a complete cure (duration of these latter, eighteen months and seven months). I am not aware of any other recorded cases of this treatment of this disease, and credit of the initiation of this treatment lies with Dr. Hope Fowler, the assistant electrician of the Royal Infirmary.

This places the first recorded use of the roentgen ray in glandular tuberculosis about the year 1900.

In 1902, F. H. Williams [2] of the Boston City Hospital, in his book reported that even the largest glands responded surprisingly well to treatment with the roentgen ray.

---

* From the Department of Surgery of Columbia University, College of Physicians and Surgeons, and of the Presbyterian Hospital, New York.

* Read before the Saranac Lake Medical Society, Jan. 9, 1924.

* Owing to lack of space, this article is abbreviated by the omission of protocols of 141 cases. The complete article appears in the author's reprints.

1. Turner, D.: A Manual of Practical Medical Electricity; the Roentgen Rays and Finsen Light, ed. 3, New York, William Wood & Company, 1902, p. 376; ed. 4, 1904, p. 397.

2. Williams, F. H.: The Roentgen Rays in Medical Work, ed. 2, New York, The Macmillan Company, 1902, p. 674.

In 1903, F. P. Vale [3] reported the case of a patient with the disease who was favorably affected following roentgen-ray treatment. Searching the literature, Vale discovered Turner's as the first record of roentgen-ray treatment of the disease.

In 1903, Pusey and Caldwell [4] reported five cases in which the patients were treated by them with favorable results.

Since 1903, there has appeared much medical writing on this subject in many languages. Most of this work has been lean in details of technic, meager in the proof of results, and almost lacking in follow-up reports; but there has constantly sounded an unmistakable ring of sincerity in the observations published proclaiming favorable and curative effects of the roentgen ray on tuberculous lymph glands. The mass of empiric evidence affords great support to the use of this therapeutic agent.

In the autumn of 1917, at the Presbyterian Hospital in New York, there was started a special clinical study of patients with tuberculous glands of the neck. This work has been consecutive and is still in progress. While controlled by the department of surgery, including outpatients and inpatients, all departments of the hospital have been available for the work. The report herein presented is that of the first four years during which efforts were mainly directed to the therapeutic use of relatively small doses of filtered roentgen ray, with follow-up results. A few of the observations herein given have appeared in a preliminary discussion of the indications for operation in this disease; [5] but I beg to submit them again in their full context.

OTHER THERAPEUTIC AGENTS USED BESIDES THE ROENTGEN RAY

It became evident from the first that treatment could not conscientiously be limited to the roentgen ray alone. Therefore, in a majority of the patients some of the following additional measures were used.

Attempts were made to improve the general hygiene.

All foci harboring simple and tuberculous infection, such as tonsils and adenoids, were treated.

Rest was prescribed as needed, sometimes rest in bed.

Cod liver oil and "tonics" were prescribed as appeared helpful.

Surgical dressings were applied to wounds and sinuses.

---

3. Vale, F. P.: A Brief Note on the X-ray Treatment of Glandular Tuberculosis, Wash. M. Ann. **2**:324, 1903.

4. Pusey, W. A., and Caldwell, E. W.: The Practical Application with Roentgen Rays in Therapeutics and Diagnosis, ed. 1, Philadelphia, W. B. Saunders Company, 1903, p. 393; ed. 2, 1904, p. 417.

5. Hanford, J. M.: The Indications for Operation in the Treatment of Tuberculous Cervical Lymph Glands, A Preliminary Report, Ann. Surg. **80**: 885 (Dec.) 1924.

Minor surgical operations, such as aspiration, incision, curettage and small biopsy, were performed.

Major operations were performed; that is, attempts were made to excise a lesion or a group of lesions.

The patient was treated for tuberculosis elsewhere in the body.

The patient was treated for ailments such as constipation or other nontuberculous disease.

Patients were urged to seek, and sometimes arrangements were made to provide, sunshine, fresh air, good food, better environment and rest. Specialists were employed to examine and to treat the nose, throat, ear, skin, mouth, eye and chest. Small doses of cod liver oil were used over long periods in almost every case.

I made nearly all of the surgical dressings and performed most of the operations. The dressings were simple, consisting largely of the use of minute amounts of 95 per cent phenol for the sinuses and of sterile petrolatum. Skin irritants were avoided during the period of roentgen-ray therapy.

OPERATIONS

It might be argued that the operations alone favorably changed the course of the disease; that they—not the roentgen ray—were the main feature of the treatment; that particularly the major operations in certain cases brought about the result. Sixty-nine of the 141 patients submitted at some time to some form of operation.

Aspiration of one cystic swelling plus twelve roentgen-ray treatments was associated with complete resolution (case 159). My experience has shown that aspiration alone has little or no therapeutic value in cystic or in fluctuating tuberculous lesions in the neck.

The operation of incision with or without curettage of sinuses or abscesses was performed forty-three times. Most of these were simple incisions of which fifteen were performed within a month before the roentgen-ray treatment was started, and twenty-eight during treatment or soon after it ended. The fifteen patients, on whom incisions were made before treatment, had reached, at the start of their treatment, the sinus stage of the disease. Of the twenty-eight patients on whom incisions were made after treatment had been begun, nineteen appeared to have had the softening induced by the roentgen-ray treatment. There were two in whom the lesions softened under roentgen-ray treatment without incision; so it is interesting to note that twenty-one of the 141 patients appeared to suffer "cold" abscess formation as a result of the roentgen-ray exposures. Incision of cold abscesses is generally admitted to be inadequate treatment.

Five partial excisions included two types of lesions. In the case of one patient there was simply excision of a protruding granuloma

over a sinus opening (case 4). In the other four there was incomplete and unsatisfactory removal of sinuses and of the indurated tissue about them (cases 114, 145, 161 and 181). In case 4, the operation was a failure, while two roentgen-ray treatments resulted in quick healing. In cases 114, 145 and 181, the operation undoubtedly played a large part in the ultimate good results. Other lesions existed in addition to those operated on, and the roentgen ray may have been an important factor in the apparent healing of these remaining lesions.

Fifteen radical excisions were made. By the term radical excision is meant an attempt to excise completely a lesion or a group of lesions. It does not necessarily include all the lesions in the neck. For example, in case 42 a mass was excised from one side of the neck before roentgen-ray treatment was started on another lesion on the opposite side. In this case the mass treated mainly by the roentgen ray became resolved and apparently remained healed. The side on which the operation had been performed was not directly treated with the roentgen ray, and the lesions recurred forty-seven months later. There were three other cases in which excisions of main lesions were made, the smaller lesions being treated with the roentgen ray. These cases have been classed according to the smaller lesions, which may or may not have been favorably influenced by the excisions. Roentgen-ray treatment of these three patients (78, 136, 150) resulted in apparent cure or in marked improvement.

Eleven patients on whom radical excisions were made belong to a third class, namely, those in whom results of roentgen-ray treatment over longer or shorter periods were not satisfactory. Sometimes the patient or I was dissatisfied too soon perhaps. Cases 109, 117, 123, 129, 133, 154, 163, 164, 173 and 176 belong in this group. The reports are based on what occurred up to the time of the radical excision, and the roentgen-ray results are given accordingly. Biopsy, or the removal for examination of a very small part of the diseased area, may be discounted as a factor in treatment.

To summarize, then, the influence which the operative procedures may have had in the results, I may say that only the partial excisions and the thorough currettings appear important. These together have influenced the course of the disease in only thirteen of the 141 patients. I believe that the surgical procedures have played but a minor part in the results presented.

Few physicians would expect definite effects on tuberculous lesions in the neck from the other general therapeutic measures used. Seven of the patients received other specific antituberculosis treatment in addition to roentgen-ray therapy. In case 10 the patient was given tuberculin at an eye clinic, for ocular tuberculosis. The ultimate effect

on the neck was slight. In cases 14 and 67, the patients received enough ultraviolet light to produce a good tan, but both required more than three years from the time of this treatment to show their ultimate apparent cure. In cases 47 and 100, the patients received good treatment at a sanatorium over several months. The former was undoubtedly thus helped to his final apparent cure, while in the latter the result was not favorable after treatment at the sanatorium. In cases 51 and 127, the patients had a whole summer's rest in the country. The former said that she thought roentgen-ray treatment brought about her apparent cure; the other showed marked improvement in the neck at the end of her rest, but she had received five roentgen-ray treatments before going to the country.

Thirty-two patients received no other treatment that might have affected the results.

It is fair to state, therefore, in studying the clinical course of the 141 patients, that the roentgen ray was the predominating specific therapeutic agent employed.

ROENTGEN-RAY DOSAGE AND TECHNIC

The roentgen-ray dosage which held good for all but a very few cases was about one third of the dose of filtered roentgen ray necessary to produce a slight erythema in an average person. In a few exceptions, curiosity led to a trial of about two thirds of the erythema dose. These exceptions are indicated in the protocols.

The patients received appointment cards with two weeks fixed as the interval between treatments. The number of treatments advised was not fixed at first but was gradually increased up to ten, which was finally chosen as the minimum number of treatments for all patients. Such a series lasted about four and one-half months. More treatments were then given to some patients who were not markedly improved by the end of the series. Some who had recurrences later received a second series of treatments. Table 1 gives the details of the roentgen-ray dosage. The hair and surrounding parts were protected with lead, although this precaution probably is not necessary in using small doses once in two weeks. At first only the diseased side of the neck was treated, but during most of the time both sides were treated. One third of the erythema dose was used on each side so that the actual dosage to the lesion was somewhat increased by this crossfiring. One "treatment" means one session of roentgen-ray exposure, whether one or both sides were treated, and always includes direct treatment to all diseased tissue in the neck. No attempt was made to exclude the salivary glands. The tonsils and pharynx were also included. The thyroid and pituitary glands were usually though not definitely exposed.

The smaller doses of roentgen ray were selected for this work because of the extreme susceptibility[6] of the lymphoid cell to the roentgen ray; because of the disadvantage of massive destruction of these cells which almost certainly play an active part in resistance to the disease;[7] because of the probable stimulating effect of small doses on the production of lymphoid cells;[8] because at the time I began, fewer reports had been published on the results of small doses than of large doses; because they are safer and can be given oftener, thus allowing the physician to observe the patients more closely; because my aim was to induce resolution without softening (softening appeared more likely to occur with the larger doses); and because it was thought the reactions from the larger doses were more likely to interfere with appetite, nutrition and general health.

The roentgen ray is essentially more convenient and less expensive than radium, and, for this disease, probably equally good.

TABLE 1.—*Details of Dosage* *

Tube	First Two Years Coolidge (Broad focus universal type)	After First Two Years Coolidge (Broad focus universal type)
Anode-skin distance	25 cm.	25 cm.
Filter	Flint glass....4 mm. Wood....1 cm. Bakelite....4 mm. Aluminum....1 mm. Leather....6 mm.	Aluminum—3 mm.
Spark-gap	8½ inches	8 inches
Milliamperes	About 5	5
Number of minutes exposure.	4 to 5	4
Milliampere minutes	21 to 25	20
Area exposed (approximate)..	7 inches in diameter	7 inches in diameter

* Interval of treatment desired was two weeks to one area. For the two periods the dosage was essentially the same, i. e., about one-third of an average erythema dose.

6. Taylor, H. D.; Witherbee, W. D., and Murphy, J. B.: Studies on X-ray Effects. I. Destructive Action on Blood Cells, J. Exper. Med. **29**:53, 1919.

7. Murphy, J. B., and Ellis, A. W. M.: Experiments on the Role of Lymphoid Tissue in the Resistance to Experimental Tuberculosis in Mice, J. Exper. Med. **20**:397, 1914.

8. Thomas, M. M.; Taylor, H. D., and Witherbee, W. D.: Studies on X-ray Effects. II. Stimulative Action on the Lymphocytes, J. Exper. Med. **29**: 75, 1919. Nakahara, W.: Studies on X-ray Effects. III. Changes in the Lymphoid Organs after Small Doses of X-rays, J. Exper. Med. **29**:83, 1919. Nakahara, W., and Murphy, J. B.: Studies on X-ray Effects. V. Effect of Small Doses of X-rays of Low Penetration on the Lymphoid Tissue of Mice, J. Exper. Med. **31**: 13, 1920. Studies on X-ray Effects. VII. Effect of Small Doses of X-rays of Low Penetration on the Resistance of Mice to Transplanted Cancer, J. Exper. Med. **33**:429, 1921. Murphy, J. B.; Liu, J. H., and Sturm, E.: Studies on X-ray Effects. IX. The Action of Serum from X-rayed Animals on Lymphoid Cells in Vitro, J. Exper. Med. **35**:373, 1922. Nakahara, W., and Murphy, J. B.: Studies on X-ray Effects. X. The Biological Action of Small Doses of Low Frequency X-rays, J. Exper. Med. **35**:475, 1922.

CONDITION OF PATIENTS AT BEGINNING OF TREATMENT

General Condition.—The group was unselected, except that patients with active pulmonary tuberculosis were usually rejected. These were placed elsewhere for treatment. Tables 2, 3 and 4 give the ages, nationalities and occupations. There were ninety-seven females and forty-four males, a ratio of more than two to one. Sixty-five of the patients had relatively normal general health and sensation except in the neck; but a large number of these had diseased foci of secondary infection; seventy-one, a majority, were below par, being pale, thin, tired, weak, nervous and having headaches or colds; three had syphilis; one,

TABLE 2.—*Ages of Patients at Start of Roentgen-Ray Treatment*

Ages, Years	No. of Patients	
1 to 10	28, about 1/3	About 5/6 were under 31
11 to 20	36, about 1/4	
21 to 30	54, about 1/3	
31 to 40	9	
41 to 50	9	
51 to 60	4	
61 to 70	1	

TABLE 3.—*Nationalities or Races*

	No. of Patients		No. of Patients
American	33, about 1/4	Finnish	3
Irish	27, about 1/5	Swedish	3
Italian	18, about 1/6	French	2
Jewish	11, about 1/12	Greek	2
Colored	10, about 1/14	Austrian	2
Bohemian	5	Danish	1
Scotch	5	Chinese	1
Hungarian	4	Polish	1
Norwegian	4	Dutch	1
German	4	English	1
Russian	3		

acromegaly; and one, simple adenomatous goiter. Of the seventy-one whose health was below par, fifty-four presented evidence of healed or active tuberculosis elsewhere than in the neck (table 5). There were thirty-one with healed tuberculosis and twenty-three with active tuberculosis. Twenty-five presented evidence of healed tuberculosis of the lungs. Thirteen patients with active tuberculosis of the lungs were admitted to the group, contrary to our general plan. Seven of these had incipient or slight chronic pulmonary disease, while six were in a febrile state. Some difficulty in the way of better care held these for a time in our group. There were ten patients with active axillary lymph gland tuberculosis. Tuberculosis of the axillary lymph glands is viewed simply as a chance extension from the neck, with or without evidence of the disease in the neck. Exceptions to this conception are such

patients as may show definite tuberculosis of an upper limb, of the breast or wall of the chest. When axillary disease coexisted, it was also treated with the roentgen ray.

Not all of the tonsils removed were examined. In three cases, however, they proved to be tuberculous. Relatively few tonsils and adenoids were removed at that time because it was hoped that the roentgen ray would tend to heal them and to decrease their size. I

TABLE 4.—*Occupations of Patients*

	No. of Patients		No. of Patients
School	43	Laundry	1
Housework	25	Chemist	1
None	15	Teacher	1
Domestic service	11	Telephone installer	1
Clerical work	9	Actress	1
Textile worker	4	Business man	1
Saleswoman	3	Barber	1
Dressmaker	3	U. S. A. air service	1
Porter	2	Bellman	1
Machinist	2	Insurance agent	1
Chauffeur	2	Shoemaker	1
Nurse	1	Ship waiter	1
Tailor	1	Janitress	1
Printer	1	Violinist	1
Attendant	1	Policeman	1
Artist	1	Pipefitter's helper	1
Telephone operator	1		

TABLE 5.—*Patients with Tuberculosis Elsewhere as Well as in the Neck, as Found at the Commencement of Treatment—54* *

(A) Healed: 31 Patients		*(B) Active: 23 Patients*	
Lungs and thoracic lymph glands	19	Axillary glands with healed tuberculosis of lungs	6
Thoracic lymph glands alone	3	Axillary glands with active tuberculosis of lungs	2
Skin	1	Axillary glands with tuberculosis of upper limb	1
Pleura alone	1	Axillary gland	1
Lower limb	1	Lungs and abdominal lymph glands	1
Upper limb	1	Lungs, tonsils and adenoids, skin (ribs developed during treatment)	1
Fallopian tubes (removed) / Peritoneum / Abdominal lymph glands	1	Lungs (and thoracic glands)	9
Axillary glands	3	Lower limb	1
Peritoneum	1	Inguinal glands	1

* Eighty-seven, or 61.7 per cent of the whole group of 141 were without evidence of healed or active tuberculosis elsewhere.

now believe that all patients fit for the operation should have their tonsils and adenoids removed, whether or not they show evidence of disease, and that this should be done at the start. This opinion is based on the inability to detect tuberculous tonsils and adenoids which may continue as active foci unless removed, despite the chance of their being cured by roentgen-ray treatment.

A composite picture of the general condition of these 141 patients shows that they were active and ambulatory, and generally able to carry on their occupations. I share with others the impression that there is a

mild tuberculous toxemia in all patients with active cervical gland tuberculosis. As a rule they are slightly below normal in health.

Local Conditions of the Neck.—As the cervical disease existed in this group, it exhibited a variety of lesions which occurred singly or in complex combinations. To analyze and classify these has been difficult. Dowd's [9] division into groups I, II, and III was first considered; but so many of our cases fell into groups II and III, that is, into the more advanced and atypic forms, that a different arrangement seemed advisable. Accordingly, they have been grouped by the specific type of lesion so that the results in several different types may be studied.

In a recent article,[10] I called attention to a working pathology of the clinical forms of the disease. Briefly it is this: 1. The first lesion is a firm swelling. This may be either large and markedly visible or only moderately large and not prominent. 2. The next phenomenon is a faintly elastic or cystic swelling. Liquefaction necrosis in the first lesion has rendered it cystic. 3. The same process brings the third lesion of definite softening and fluctuation, the "cold abscess." 4. The spontaneous or surgical opening of the cold abscess produces the sinus, the fourth lesion. The four main types of the disease are: firm swelling, cystic swelling, fluctuating soft swelling (that is, "cold abscess") and a sinus that tends to persist. There are two others which are of less importance clinically because their treatment is included, as a rule, with that of the four main lesions. These are first, skin tuberculosis at sinus openings and in the walls of abscesses, and secondly, extreme fibrosis. Ugly scars are frequent sequelae of the disease, and it has been interesting to see the apparently favorable effect of roentgen-ray treatment on them.

The enlarged firm swellings have been divided into two groups, large and small. There is a difference in the actual mass of disease in these two groups, and larger swellings are decidedly more of a therapeutic problem. The large swellings have been designated as those estimated to be more than 2 cm. in diameter and the small swellings as those under 2 cm. Thus there may be a swelling of a single gland or of a group of glands. Many of the patients had more than one type of lesion. I shall discuss the results of treatment both on the patients and on the various lesions studied as pathologic-clinical entities.

There were 115 patients who at the beginning of roentgen-ray treatment had firm swellings, of which sixty-eight were large and forty-seven small. Ten had cystic swellings; nine had cold abscesses;

9. Dowd, C. N.: Tuberculosis of the Cervical Lymphatics, J. A. M. A. **67**:499 (Aug. 12) 1916.

10. Hanford, J. M.: Some Applied Pathology of Tuberculous Cervical Lymph Glands, Internat. Clin. **4**:115, 1923.

and fifty-six had sinuses. One hundred patients had but a single type of lesion at the beginning of roentgen-ray treatment. Forty-one had two or more types. This grouping of the single types of lesions does not apply entirely to the cases in which there were enlarged glands, for despite the presence of smaller glands in some of the patients with large glands, these cases were listed only as cases of large glands. Many of the patients in the sinus stage of the disease were so classified because the cold abscesses had been incised within a month before the first roentgen-ray treatment. These could not be said to have had "persistent" sinuses, but it is believed that they were potentially "persistent." A sinus may be called persistent if it does not heal within two months after its appearance. The majority of the abscesses incised just before roentgen-ray treatment actually resulted in such persistent sinuses.

TABLE 6.—*The Period Elapsed (as Taken from the Clinical Histories) from the First Appearance of Tuberculosis in the Neck Until the Beginning of Treatment**

6 months or less	38 patients	4 to 5 years	6 patients
6 to 12 months	22 patients	5 to 10 years	21 patients
12 to 18 months	3 patients	10 to 15 years	9 patients
18 to 24 months	10 patients	15 to 20 years	7 patients
2 to 3 years	13 patients	20 to 40 years	2 patients
3 to 4 years	10 patients		
			141 patients

Thus over two-thirds of the patients had first had a tuberculosis in the neck more than six months prior to roentgen-ray treatment; about three-fifths more than twelve months; over one-half more than eighteen months.

* These earliest lesions may or may not have healed before patients joined this group. This table is shown simply to indicate the persistence and recurrence evident in this group of patients.

Table 6 shows how long prior to the first roentgen-ray treatment the patients had had tuberculosis in the neck. Many of these earlier lesions had disappeared or healed before the appearance of the new ones which brought the patients under my care.

EVIDENCE OF TUBERCULOSIS

In 56 per cent of the cases the diagnosis was based on microscopic examination of tissue, on inoculation of guinea-pigs or on roentgen-ray evidence of calcification [11] corresponding to the lesions in the neck. These cases have been considered as "proved" tuberculous. In the remaining 44 per cent, the diagnosis was based on the clinical picture, including history, physical findings and the course of the disease. These are the cases "accepted" as tuberculous. The evidence for the diagnosis in each case is given in its protocol. Most of them were diagnosed as tuberculous by several clinicians. All doubtful cases have been excluded.

11. Hanford, J. M.: The Roentgen Ray Diagnosis of Tuberculous Cervical Lymph Glands, Am. J. M. Sc. **164**:539 (Oct.) 1922.

TREATMENT

The Value of Treatment.—It is almost impossible to prove the effect of any particular form of conservative treatment for a disease which tends to heal spontaneously, though slowly, and which usually responds slowly to all conservative treatment. I shall discuss conservative treatment, not radical excision. Conservative treatment, as I have indicated in a recent paper,[10] means any method of treatment short of an attempt to excise a lesion or a group of lesions.

Three questions must be considered. 1. Has treatment altered the natural course of events? 2. Does one method of treatment take effect more quickly than others? 3. Does one method of treatment give more permanent results than others?

Since in many cases of various types the disease apparently disappears or there is great improvement for varying periods without treatment, evidence in favor of a method of treatment must include these points:

1. The patient must show definite improvement within a reasonable length of time; in other words, there must be a significant time ratio between the duration of the disease before treatment and the appearance of definite improvement after the beginning of treatment.

2. The longer the follow-up period, the more conclusive is the evidence concerning the durability of the improvement.

3. A given method of treatment must be compared with the natural course of the disease and with other methods of treatment.

The disease does not disappear spontaneously in all cases; sometimes it persists for years. However, significant data on a large untreated group are not available for comparison. Many factors influence resistance and resolution, such as the general condition and age of the patient, pulmonary tuberculosis, the extent of the disease in the neck and the virulence of the infection. These factors vary considerably in different parts of the world.

It may be assumed that New York City has advantages over other localities here and abroad where studies of treatment have been made and reported. In New York the milk supply has been well controlled for many years; free hospitals abound, and people tend to seek medical aid early; pulmonary tuberculosis is on a steady decline; the poor are chiefly immigrants or the children of immigrants, and these people are generally healthier than their relatives in Europe.

Analysis of Observations from Beginning of Treatment.—An analysis of the protocols of the 141 patients, including an analysis of the lesions of the neck, has led to the tabulation of some of the results and to a simple statement and discussion of others.

If tables [12] 7, 8 and 9, are examined, it will be seen that about two thirds of all the patients had had the active disease in the neck for more than six months before roentgen-ray treatment was given; and that about one half of them had had it for more than eighteen months. In table 8 it is seen that more than three fifths of all the patients showed some degree of local improvement within two months after the first roentgen-ray treatment, and about four fifths of them within three months. Table 9 indicates that about two fifths of all the patients showed marked improvement within three months after the first treatment; three fifths within six months; and nearly four fifths, a great majority, within nine months. These facts indicate answers to question 1 and to proposition 1 in the preceding paragraphs. In a majority

TABLE 7.—*Duration Before Treatment of the Active Lesions Treated*

2 months or less	25 patients	4 to 5 years	3 patients
2 to 4 months	15 patients	5 to 10 years	13 patients
4 to 6 months*	12 patients	10 to 15 years	4 patients
6 to 12 months	29 patients	15 to 20 years	2 patients
12 to 18 months†	3 patients	20 to 40 years	2 patients
18 to 24 months	10 patients	Record not obtained	2 patients
2 to 3 years	11 patients		
3 to 4 years	10 patients		141 patients

* Eighty-nine, a little less than two thirds, had had their active lesions for more than six months before treatment.
† A little less than one half, for more than eighteen months.

TABLE 8.—*The Period After the First Roentgen-Ray Treatment Before the Appearance of Any Improvement*

1 month or less	62 patients	Over 4 months	6 patients
1 to 2 months*	29 patients	None	13 patients
2 to 3 months†	15 patients	Doubtful	8 patients
3 to 4 months	8 patients		141 patients

* Ninety-one, over three fifths, within two months.
† One hundred and six, nearly four fifths, within three months.

of the cases treatment appears to have altered the natural course of events, and the patients have shown definite marked improvement within a reasonable length of time.

Further, from table 10 it appears that almost one half of the patients were apparently cured in a fair average time of ten months from the first treatment. Only such patients as were apparently cured at their

12. The term "marked improvement" is used to mean so great a decrease in the size of swellings that they become barely visible and possibly healed. Marked improvement usually implies that conservative treatment has been satisfactory to patient and physician alike. In "apparent cure," the contour of the neck has returned to normal; swellings have either gone or become mere kernels; and sinuses have healed securely. I prefer this term to the term "cure." A "fair average" has been reached by eliminating isolated extremes, with the hope of obtaining more reliable generalizations to point the way.

latest follow-up visit are included here. This period of time for the attainment of apparent cure is shorter by a month or so than the period indicated by Metcalf [13] for tuberculin treatment. Metcalf states that "purely glandular cases respond, as a rule, to tuberculin treatment within a year." In his own series, the average duration of treatment of patients who did not have pulmonary involvement was fourteen months and twelve days. Rollier [14] states that "under the influence of heliotherapy the healing of tuberculous glands is almost invariably rapid, three to six months usually being sufficient to cause permanent arrest of the disease in a case uncomplicated by septic infection." Yet no confirmative data are presented except the case of a patient whose lesions did

TABLE 9.—*The Period After the First Roentgen-Ray Before the Appearance of Marked Improvement*

3 months or less*	52 patients	Over 12 months	8 patients
3 to 6 months†	33 patients	None	21 patients
6 to 9 months‡	17 patients	Doubtful	4 patients
9 to 12 months	6 patients		141 patients

* About two fifths.
† Three fifths within six months.
‡ Nearly four fifths within nine months.

TABLE 10.—*An Indication of the Time Required for the Attainment of Apparent Cure*

	Fair Average Time
Small glands	10 months
Large glands	17 months
Cystic swellings	5 months
Sinuses	8 months
	4) 40
	10 months

Sixty-seven patients, or 47.5 per cent of the group as a whole, became apparently cured in a fair average time of ten months from the first roentgen-ray treatment. Only those are included who appeared cured at their latest follow-up visits.

not heal for eleven months after the beginning of heliotherapy at Leysin. I saw another patient who was apparently cured after having been retained at Leysin eleven months for treatment.

One hundred and eleven patients (78.7 per cent) received five or more treatments, while thirty received fewer than five. In these thirty the treatment was not effective in 50 per cent as against the group as a whole, in which the treatment failed in only 29.1 per cent. Only slight improvement may be expected from fewer than five treatments.

13. Metcalf, W. B.: Tuberculosis of the Lymphatic System, New York, The Macmillan Company, 1919, pp. 249-260.

14. Rollier, A.: Heliotherapy, London, H. Frowde, 1923, p. 106 and p. 249.

The advocates of small doses are beginning to recommend the continuance of treatment even after apparent cure or marked improvement. L. J. Carter [15] recommends twenty-four treatments with relatively small doses. I feel that it is advisable to give more than ten treatments over a period of from six to ten months. It is interesting to note that this is about the period found advisable by the advocates of tuberculin (Metcalf [13]), and of natural heliotherapy with life in the open air (Rollier [14] and LoGrasso [16]).

Recurrence in the original or in new lesions of the neck was found in twenty-seven patients who had shown marked improvement or apparent cure following the roentgen-ray treatment. Had these cases not been followed up, they might have been considered uninterrupted "cures." Eleven recurrences were patently due to active foci of secondary infection, either chronic or incidental. Three patients had syphilis and refused antisyphilitic treatment. Their glands, however, were definitely tuberculous. Two had pulmonary tuberculosis. Eleven recurrences were not explained.

The importance of clearing up and of preventing active foci of secondary infection is the main point in the whole question of recurrence. Recurrences may occur after any method of treatment, for living tubercle bacilli may be retained and may become active during an acute respiratory infection. A method of treatment which will insure complete destruction of the bacilli is not known, and these bacilli may cause recurrences decades after their original activity. Small nodes, apparently healed, sometimes enlarge slightly during an acute infection of any kind and then quickly subside. This is probably not a recurrence but a simple infection, and it indicates that neither the disease nor the treatment has blocked the lymphatics connected with these glands. The supposed fibrosis might be expected to do this, and does in some cases. The causal relation of the roentgen ray to fibrosis in this disease is difficult to estimate, because fibrosis without the roentgen ray is often a striking feature of the pathologic change.

Improvement in general health was noticed in fifty-two of the 141 patients during or soon after their period of treatment with the roentgen ray. There was a tendency for fewer infections of the head and throat to occur. This gives rise to the theory that roentgen-ray treatment of an active tuberculous lesion produces an effect like that of tuberculin. If this could be proved, it might have valuable practical application.

---

15. Carter, L. J.: The Treatment of Tuberculous Cervical Adenitis; Results from Use of Fractional X-ray Dosage in 100 Cases, J. Radiol. **2**:22 (Sept.) 1921.

16. LoGrasso, Horace: Heliotherapy in Tuberculosis, New York State J. Med. **22**, No. 6 (June) 1922.

Only slight and occasional temporary, harmful constitutional effects resulted from these small doses. A boy, aged 6 (case 93), received fifty-six treatments of the neck in interrupted series over a period of three years. Twelve months after the last treatment, the neck was relatively normal, and he appeared to be unharmed by the treatment. Evidently the skin, thyroid, pituitary and salivary glands were not injured. His complete blood count was normal. Another patient (case 14), a young woman who had received forty-nine treatments, presented the same observations.

A few patients, not more than five or six, experienced immediate or early unpleasant effects from treatments with small doses. Two noticed itching or burning of the feet. Three felt nausea the same or the next day. One appeared greatly disturbed; she had pains, vomited and felt depressed. Decrease in dosage decreased the symptoms in all the patients.

Nine patients presented cold abscesses at the beginning of the roentgen-ray treatment. Some of the abscesses opened spontaneously; some were incised, and some were excised. Resolution did not occur otherwise in any of them. Only two of the abscesses which were incised were curetted, and curettement was incomplete. All the abscesses finally healed, except the one which received only one roentgen-ray treatment.

There was one cystic swelling which became an abscess during treatment and finally resolved without opening or incision (case 56). This was the only instance of such resolution.

I believe that cold abscesses should be excised or incised and curetted before roentgen-ray therapy is given. Aspirations have been tried and abandoned. Cold abscesses as such are not in a condition to receive maximal benefit from roentgen-ray therapy in smaller doses, except as increased softening and liquefaction may ensue therefrom.

Roentgen-ray treatment of new and old scars has appeared to be effective. They are made smoother, softer, paler, more pliable and less conspicuous. During the period of roentgen-ray treatment, the skin must be protected from other irritants. Iodine and sunlight are the commonest, but all topical remedies must be free from irritating qualities.[17] One patient, a girl of 17, was urged to take sunbaths (case 176). She did so and included the neck. She then received two treatments over this sunburned skin. When seen within a few months, and again three years later, she showed visible telangiectases—like a "birthmark." This is the only instance of local, permanent injury attributable to the treatment, and it should have been avoided. On the

17. MacKee, G. M., and Andrews, G. C.: Injurious Combined Effect of Roentgen Rays or Radium, and Topical Remedies, J. A. M. A. **77**:1489 (Nov. 5) 1921.

other hand, a number of the patients were quickly relieved of the slight pain and soreness felt in the neck before treatment.

Enlarged glands showing large areas of calcification in a roentgenogram may nearly disappear under roentgen-ray therapy, so that the contour of the neck returns to normal. In other cases, extensive calcification may limit the decrease in swelling.

From these studies I have observed that lesions in the lower part of the neck, mainly in the supraclavicular region, resolve more readily than those above. This may be due partly to their relative immobility, their distance from the common foci of secondary infection and their protection by the clothing. However this may be, I find that it is often difficult to make a radical excision because they adhere to the subclavian and to the lower part of the internal jugular vein and to the thoracic duct.

The follow-up period of from two months to five years after the last treatment (table 11) is too short to warrant final conclusions as to

TABLE 11.—*The Follow-Up Period After the Last Roentgen-Ray Treatment*

Number followed, 120, or 85.1 per cent. The fair average follow-up period for the group of 141, as a whole, was 13.1 months. Of the 141, sixty-one, or 43.9 per cent, were followed for more than one year. A few were followed for four years or more.

19	patients were followed for 6 months or less
39	patients were followed for 6 to 12 months
30	patients were followed for 12 to 24 months
31	patients were followed for over 24 months
1	patient was followed with record of time doubtful

the permanence of the improvement. It is certain, however, that there are unexplained recurrences in the same, or in new areas, even in necks apparently cured, and after many treatments.

While the literature has not revealed statistics on this point, I have concluded that slight improvement and probably marked improvement and apparent cure are noticed sooner after the beginning of roentgen-ray treatment than after any other form of conservative treatment, particularly tuberculin treatment and perhaps heliotherapy.[18] If this is true, it gives roentgen-ray therapy the advantage of earlier encouragement to patient and physician. Another comparative advantage of the roentgen-ray over tuberculin is its apparent safety immediately after operation on tuberculous tissue, and also in the presence of fever. The small doses insure slight (if there be any) tuberculinization. After working personally with tuberculin and with roentgen ray, I feel that the roentgen ray is far superior to tuberculin, from every standpoint: and that if the roentgen ray is used, tuberculin is not necessary.

If five cases showing unusual irregularity of treatment are eliminated, the average period of roentgen-ray treatment for the 141 patients

18. Heliotherapy at certain geographical points probably is superior.

as a group was 6.56 months. Fifty-eight patients actually received consecutive treatment for six months or more; eighty-three, for less than six months.

There were six deaths. Three were caused by pulmonary tuberculosis; one by abdominal tuberculosis. These patients were among those difficult to place in sanatoriums at the beginning. A colored child (case 103) died of acute miliary tuberculosis after having developed dactylitis and Pott's disease following a partial excision in the neck, and after roentgen-ray treatment to the neck was begun. This is the only patient of the whole series who may have had serious constitutional effects from the treatment, that is, from overirritation (?) of an active lesion. One patient died of intercurrent disease which did not bear any relation to the tuberculous glands.

Table 12 indicates the incidence of tuberculosis developing elsewhere during or soon after the period of roentgen-ray treatment. I cannot account for the development of the condition in the eyes. The

TABLE 12.—*Active Tuberculosis Elsewhere Than in the Neck or Axilla, Which Developed During or Soon After the Period of Roentgen-Ray Treatments*—7 Patients*

Eye	2 patients
Eye, dactylitis, spine	1 patient, a small colored boy who later died of acute miliary tuberculosis
Ribs, skin, lungs (tonsils and adenoids)	1 patient, a small colored boy
Tonsils and adenoids	3 patients; found tuberculous after removal

* The tonsils and adenoids were probably tuberculous before treatment.

two colored boys should have received country air and sun. All tonsils and adenoids removed from patients with enlarged cervical or axillary glands should be examined for tuberculosis.

A study of the literature, perhaps not complete, has failed to reveal convincing follow-up results on any conservative method of treatment. Large and small doses of roentgen ray, tuberculin, heliotherapy, injections and aspirations,[10] Beck's paste, autogenous vaccine plus tuberculin,[20] hyperemia and simple hygienic treatment have not been reported on in sufficient detail in regard to follow-up results. Statistically, in selected cases radical surgery[9] appears to give better results than any other single form of treatment. It conforms to the three test questions stated. Attempt at radical surgical removal is applicable only to a certain percentage of cases as even today many patients do not come to our clinics for treatment until they are in the advanced stages of the disease.

19. Calot, F.: Indispensable Orthopedics, ed. 2, London, Baillière Tindall & Co., 1921.

20. Bonime, Ellis: Tuberculin and Vaccine in Tubercular Affections. Troy, N. Y., The Southworth Company, 1917.

The disease is so frequently self-limited, with varying success, that assumed results following any method of treatment must be analyzed critically. Furthermore, recurrences and recrudescences often appear so late in life and so long after the disease has subsided, that a report on a large series of permanent cures is almost impossible in one generation. If compelled, then, to deal with facts in such a study as this, the number and value of the justifiable conclusions are not such as to make the reader enthusiastic about the benefits of any plan of conservative treatment. A comparison of different plans would be more helpful were it not for variations in the stages of the disease, in age, race and environment, and for the usually unknown incidence of the types of bacillus encountered.

CONCLUSIONS

1. Small doses of filtered roentgen ray given at intervals of less than three weeks appear to shorten the course of the disease and to favor resolution or marked improvement in all stages (except cold abscesses) in a sufficiently large percentage of cases to justify the conclusion that the roentgen ray is useful in the treatment of tuberculous glands of the neck.

The usefulness of roentgen-ray treatment compares favorably with that of other single methods of conservative treatment; but adequate data on all methods, especially follow-up results, are lacking.

2. A definite superiority of small doses of filtered roentgen ray over other single forms of conservative treatment cannot be proved, but is supported by these observations. (Natural heliotherapy at selected sites may be superior but should not exclude roentgen-ray therapy.)

3. This form of roentgen-ray treatment apparently does not cause undesirable effects not easily avoided.

4. Small doses of the roentgen ray are inferior to the radical surgical treatment as reported by Dowd.[9] However, his patients on whom radical operation was strikingly successful belonged to a selected group composed largely of children, most of whom were operated on in the early stage of the disease. Hence, even radical surgery might give little better results than the roentgen ray in such an unselected group as this, in which most of the patients were older and were in advanced stages of the disease.

5. From a study of the lesions (tables 10 and 13) I found that: (*a*) The best results appeared in the treatment of patients who had tuberculous sinuses, of whom 76.8 per cent apparently were cured. Eight months after the first treatment was the fair average time for the attainment of apparent cure. The sinuses, however, received the largest number of treatments. (*b*) The small glands (2 cm.—) improved more satisfactorily than the large glands (2 cm.+). (*c*) Forty per cent of

the cystic swellings resolved without incision or spontaneous opening. Hence, some cystic swellings resolved and are therein different from the definite abscesses. (*d*) The cold abscesses all resulted in sinuses. These abscesses are not suitable for treatment with the small doses of the roentgen ray except as this treatment may increase liquefaction prior to incision.

TABLE 13.—*Summary of Results*

		Types of Lesions					
	The Patients	All Enlarged Glands, Large and Small	Large Glands 2 Cm.+	Small Glands 2 Cm.—	Cystic Swellings	Cold Abscesses	Sinuses
Number	141	115	68	47	10	9	56
Fair average duration of active lesions before roentgen ray	See table 7	31.8 mos.	39.2 mos.	24.5 mos.	1.36 mos.	2.6 mos.	6.8 mos.
Fair average number of treatments	9.4	9.8	11.1	8.6	8	11.7	12
Fair average period of treatments	6.56 mos.	7.2 mos.	8.3 mos.	6.1 mos.	4.4 mos.	10.4 mos.	8.8 mos.
Fair average interval between treatments*	19.5 days	19.7 days	19.9 days	19.5 days	16 days	21 days	21 days
Fair average time after start of roentgen ray for appearance of slight improvement	See table 8						
For appearance of marked improvement	See table 9						
For marked improvement or apparent cure	....	9.8 mos.	11.5 mos.	8.1 mos.			
For appearance of apparent cure	See table 10	.....	.....	.....	5.3 mos.	.....	8 mos.
Fair average, follow-up period for one patient	13.1 mos. see table 11	12.0 mos.	10.7 mos.	13.4 mos.	15 mos.	18 mos.	17.9 mos.
Slight or no improvement at last follow-up visit	41 29.1%	29 25.2%	19 28%	10 21.3%	..	..	13 23.2%
Marked improvement through last follow-up visit	33 23.4%	34 29.6%	24 35.3%	10 21.3%			
Apparently cured, through last follow-up visit · see table 10	67 47.5%	52 45.2%	25 36.7%	27 57.4%			43 76.8%
Marked improvement or apparent cure through last follow-up visit	100 70.9%	86 74.8%	49 72.0%	37 78.7%			

* Though the desired interval was two weeks between treatments, various causes lengthened the actual average interval.

6. From table 13, allowing "fair averages," it is seen that the whole group of 141 patients with all types of lesions in the neck received 9.4 treatments during 6.56 months, with an interval of 19.5 days between treatments.

7. Table 10 shows that 47.5 per cent of the whole group apparently were cured in a fair average time of ten months from the first treatment. Only those who were apparently cured at the time of their latest follow-up visit are included.

8. In addition to those who apparently were cured, 23.4 per cent of the whole group were so markedly improved when last seen as to make the treatment appear satisfactory.

9. At the end of a fair average follow-up period of 13.1 months (table 11), conservative treatment, with small doses of filtered roentgen ray as the main agent, appeared satisfactory in 70.9 per cent of all the patients.

10. Tuberculosis of the cervical lymph glands is primarily a surgical problem because, even with conservative treatment, surgical judgment, minor operations and careful surgical dressings play an important rôle. Indeed, major operations are frequently indicated.

11. Treatment of the disease should be comprehensive and not limited to any single method.

POSTOPERATIVE HYPOGLYCEMIA *

LEE FOSHAY, M.D.
George W. Crile Fellow in Research Medicine
AND
DOUGLAS BOYD, M.D.
CLEVELAND

As the study of postoperative hypoglycemia is still a subject of interest to both surgeon and internist, we consider the following study worthy of report. The work is unavoidably incomplete, and there are only a few cases. However, the method of investigation is new, and the results obtained by its use give infinitely greater understanding of the significant changes in carbohydrate metabolism than does the older method of studying only the whole blood sugar. This method is offered to those who care to study the condition further, with the hope that it will be employed, and with the belief that the results will be of greater physiologic significance than those obtained by any other of the present methods. The method was devised by one of us (L. F.) for the study of insulin reactions.[1] It is simple and can be carried out in any laboratory or well equipped office.

The stimulus for this work was found in Holman's preliminary report on hypoglycemia following thyroidectomy for exophthalmic goiter.[2] He showed that the blood sugar might be below the normal limit, usually from twenty-four to thirty-six hours after operation, and suggested that this hypoglycemia might be at least partly responsible for the postoperative reactions. This opinion was suggested by the close resemblance of many of the reactions to the well known insulin reaction, and was strengthened by observing the marked clinical improvement in the patient after the intravenous administration of solutions of dextrose. Our results tend to confirm the report of Holman.

The method depends on a study of the distribution of glucose between plasma and erythrocytes in serial samples of oxalated venous blood. In collecting the specimens of blood, care must be observed to prevent accumulation of erythrocytes in the vein by prolonged use of the tourniquet. A sample is taken before operation. After operation samples are taken serially as often as desired—sometimes this extends

---

* From the Departments of Medicine and Surgery of Western Reserve University and Lakeside Hospital.

1. Foshay, L.: Observations Upon the Action of Insulin on the Blood with Special Reference to the Cause of the Condition Known as Hypoglycemia, Am. J. Physiol. **73**:470 (July) 1925.

2. Holman, E. F.: Hypoglycemia in Exophthalmic Goitre. A Preliminary Report, Bull. Johns Hopkins Hosp. **34**:69 (Feb.) 1923.

over a period of several days. If any unusual symptoms are observed in the patient, a sample is taken immediately.

In our work, determinations of blood sugar were made on the whole blood in the usual manner. Any accurate method may be used. The remaining blood was centrifugalized in a calibrated tube until the cells were packed into a homogeneous mass. We found that 1,500 revolutions a minute for fifteen minutes was sufficient. The volumes of the whole blood and of the cells were then read, and the proportions of plasma and cells calculated. A determination of the sugar was made on plasma, and the corpuscular glucose was calculated according to the following formula:

$$\text{Cell sugar per cent} = \frac{\text{whole blood sugar per cent} - (\text{plasma sugar per cent by plasma volume per cent})}{\text{cell volume per cent}}$$

Each determination of sugar was made in quadruplicate by the method of Hagedorn and Jensen.

Eight patients were studied; on four, thyroidectomies had been performed for exophthalmic goiter; on two, herniorrhaphies; a large lipoma had been excised from the region of the shoulder on one, and on the other a cholecystectomy had been performed.

The first patient with a goiter who was studied had had a subtotal thyroidectomy performed thirty hours before we saw her. About twenty-four hours after operation, tachycardia, flushed skin and profuse perspiration were observed, and she complained of profound weakness. This reaction was transient and strongly suggested a deficiency of available glucose in the tissues of the body. The first specimen of blood was examined six hours after the reaction and showed a normal content of glucose in both plasma and cells. Eighteen hours later, or forty-eight hours after operation, the patient had a similar but milder reaction. Analysis of the blood showed a normal content of glucose in the whole blood and plasma but a marked reduction of corpuscular sugar. This reaction was also of brief duration, and treatment was not required. No more reactions occurred. Examination of the blood two days later showed a normal distribution of glucose.

The second patient with goiter had determinations of the sugar made before operation and at five different intervals after operation. No reactions were observed, and there were no variations in either the concentration or the distribution of blood glucose. The low reading of the plasma sugar in the specimen of blood taken forty-seven hours after operation was probably an error.

The last two patients with goiter were first seen during similar reactions. In one case, the reaction was mild and associated with a moderately low corpuscular sugar and normal plasma sugar. It disap-

peared promptly after some food was given by mouth. The blood sugar was normal in both plasma and cells the next morning.

In the fourth case the reaction was severe. The patient was semicomatose and unable to talk. The blood showed an extremely low sugar content, and the corpuscular sugar was not measured. The patient was immediately given 200 cc. of orange juice and 5 per cent dextrose rectally. All symptoms and signs disappeared during the next two hours. The blood sugar rose to a normal level, and the patient recovered. The data for these four patients are given in detail in table 1.

Reduction of corpuscular glucose without an abnormally low whole blood sugar was noted in the blood of two of the other four patients. There were two periods of cytoglycopenia in the patient who had a lipoma excised from the shoulder; one occurred twenty-nine hours, and

TABLE 1.—*Blood Sugar Determinations on Four Patients on Whom Thyroidectomies Were Performed*

Case	Date 1926	Hours Post-operative	Blood Sugar Per-centage	Plasma Sugar Per-centage	Cell Sugar Per-centage	Cells Per-centage	Serum Per-centage	Remarks
1	1/29	30	0.161	0.166	0.150	33	67	
	1/30	48	0.106	0.129	0.044	27	73	Slight reaction
	2/ 1	103	0.143	0.154	0.113	27	73	
2	3/29	..	0.152	0.173	0.124	43.4	56.6	Preoperative
		6	0.175	0.195	0.135	33.6	66.4	Normal postoperative course
	3/30	22	0.161	0.161	0.161	36.6	63.4	
		30	0.159	0.155	0.166	34.8	65.2	
	3/31	47	0.146	0.079	0.285	32.4	67.6	
	4/ 1	71	0.163	0.154	0.180	34.3	65.7	
3	4/12	72	0.110	0.125	0.047	28	72	Mild reaction
	4/13	97	0.131	0.136	0.117	26.5	73.5	
4	3/ 8	..	0.09	.....	.....	....	....	Severe reaction
	3/10	48	0.025					
	3/12	96	0.10					

the other fifty-three hours, after operation. In the other patient there was only one such period fifty hours after a bilateral femoral herniorrhaphy had been performed.

It is interesting to note that even with such low concentrations of corpuscular glucose, no symptoms were felt except hunger, and no abnormal physical signs were found. This is so contrary to the reaction following a large dose of insulin, that it is worthy of notice. As has been shown elsewhere,[1] the symptoms and signs of insulin reactions appear when the corpuscular glucose has been reduced to about 40 mg. per hundred cubic centimeters. This is true regardless of the levels of the whole blood and plasma sugar at that time; they may be high, normal or low while the reaction is taking place. It is significant that these two patients complained of hunger at the time the corpuscular glucose concentrations were low. Each patient had had a long period of ether anesthesia, and had gone forty-eight hours practically without ingestion of carbohydrate. Hunger is frequently the first symptom noted in the

beginning of an insulin reaction. We believe that the cause of the hunger sensation in our patient is the same as that in the patient experiencing an insulin reaction, namely, a reduction of glucose in the cells of the body tissue, of which the measured corpuscular glucose concentration is an index. The work of Macleod [3] on the relation of fixed tissue cell sugar to the onset of insulin reactions furnishes evidence which strongly supports this opinion.

The cause of the symptoms and signs in the patients on whom thyroidectomies were performed is probably the same—a lowered cellular sugar content throughout the body. The underlying physiologic

TABLE 2—*Blood Sugar Determinations on Four Patients Following Operations*

Case	Date 1926	Hours Postoperative	Blood Sugar Percentage	Plasma Sugar Percentage	Cell Sugar Percentage	Cells Percentage	Serum Percentage	Remarks
				Excision Lipoma				
1	1/12	0	0.110	0.097	0.125	45.7	54.3	Preoperative
		5	0.153	0.168	0.128	38	62	
	1/13	22	0.161	0.160	0.162	40	60	Liquid diet
		29	0.108	0.138	**0.058**	37.5	62.5	Hunger
	1/14	45	0.173	0.180	0.160	36.2	63.8	
		53	0.113	0.177	**0.017**	40	60	Hunger
	1/15	77	0.152	0.120	0.212	34.5	65.5	
	1/17	120	0.104	0.124	0.071	38	62	
				Femoral Herniorrhaphy				
2	1/15	0	0.120	0.120	0.120	44.4	55.6	Preoperative
		7	0.125	0.110	0.142	46.6	53.4	
	1/16	25	0.144	0.129	0.161	45.7	54.3	Liquid diet
	1/17	50	0.132	0.182	**0.057**	40	60	Hunger
	1/18	72	0.164	0.181	0.139	40.4	59.6	
	1/20	121	0.124	0.143	0.093	38	62	House diet
				Herniorrhaphy				
3	1/26	0	0.119	0.132	0.097	38	62	Preoperative
	1/28	48	0.132	0.138	0.123	40	60	Normal postoperative
		55	0.113	0.113	0.113	36	64	course
	2/ 1	157	0.168	0.177	0.152	36	64	
				Cholecystectomy				
4	2/ 5	0	0.106	0.105	0.107	38	62	Preoperative
		7	0.164	0.202	0.104	38	62	Normal postoperative
	2/ 6	24	0.159	0.159	0.159	33	67	course
	2/ 8	78	0.155	0.168	0.123	29	71	

mechanism may be slightly different. These patients have had a high metabolic rate for a considerable period, have lost much weight and have probably seriously depleted their stores of glycogen. The sudden increase in metabolism incident to manipulating the thyroid gland during, and shortly after, the operation may cause a temporary excessive burning of carbohydrates which cannot be met by glycogenolysis from the already depleted liver and muscle stores; hence, the low general tissue sugar, low corpuscular sugar and the associated insulin-like reactions. In this connection it is of interest to note that the patient who did not

3. Macleod, J. J. R.: The Problem of the Fundamental Action of Insulin, Canad. M. A. J. **15**:476 (May) 1925.

have any symptoms after thyroidectomy was in a good state of nutrition. The other three patients who had reactions were thin, underweight and obviously in a poor nutritional state.

SUMMARY AND CONCLUSIONS

Some of the symptoms and signs of postoperative reactions are caused by a depletion of sugar in the tissues, a cytoglycopenia. They may or may not be associated with a hypoglycemia, if by that term a low whole blood sugar is meant.

A method is presented which enables one to gain some insight concerning the amount of glucose in the tissues by studying the concentration and distribution of glucose in the blood plasma and erythrocytes.

If methods of study are limited to the one of determinations of whole blood sugar, much useful information concerning carbohydrate utilization will be overlooked.

THE VARYING DEGREES OF ANEMIA PRODUCED BY CARCINOMA IN DIFFERENT PARTS OF THE COLON *

WALTER C. ALVAREZ, M.D.

E. STARR JUDD, M.D.

WILLIAM C. MacCARTY, M.D.

AND

ARNOLD R. ZIMMERMANN, Dr. ès. Sc.

ROCHESTER, MINN.

In 1913 and 1921 W. J. Mayo [1] called attention to the fact that carcinoma of the proximal half of the colon has a greater tendency to the production of anemia than carcinoma of any other part of the body, with the exception of the median portion of the stomach. As this observation gives rise to a number of interesting questions, many of them of considerable clinical importance, it seemed worth while to follow it up with a statistical analysis to see, first, how definite the peculiarity is, and, second, what explanation can be found for it.

For the purposes of this study, we have gone over the records of most of the cases of cancer of the colon in which operation was performed at the Mayo Clinic during the last twenty years, and have divided these cases into a number of groups according to the situation of the tumor, the sex of the patient, the number of red cells and the percentage of hemoglobin in the blood (Dare method). The frequency distributions with the corresponding means (or averages) will be found in tables 1, 2 and 3. The trend of the means is shown in chart 1, where the relation between the degree of anemia and the situation of the tumor in the bowel stands out strikingly.

Chart 2 shows in another, and perhaps more convincing way, the difference in the severity of the anemia with cancer in the right and left halves of the colon. There it may be noted how much more frequently low hemoglobin readings of from 30 to 50 per cent are found with tumors on the right side. Without these big differences in the distribution curves, we might have felt some doubt about the reliability of the averages because, as is well known, the Dare hemoglobinometer

* From the Divisions of Medicine, Surgery and Pathology, Mayo Clinic.

1. Mayo, W. J.: Some of the Disputed Problems Associated with Surgery of the Large Intestine, Am. J. M. Sc. **145**:157-161, 1913; Pernicious Anemia with Special Reference to the Spleen and the Large Intestine, Ann. Surg. **74**:355-359 (Sept.) 1921.

is not an exact instrument; the laboratory worker has generally to take the mean of two or three readings on the same sample, and these estimates vary through a range of 5 per cent or more. Fortunately, however, when 100 such means are averaged, negative errors tend to balance positive ones, and the first two figures in the result become quite trustworthy. If doubts had remained, we would have based our

TABLE 1.—*Red Cell Counts and Hemoglobin Readings with Carcinoma in Different Parts of the Colon* *

Red Cells, Millions	Cecum		Ascending Colon and Hepatic Flexure		Transverse Colon		Descending Colon and Splenic Flexure		Sigmoid		Rectum	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
1.500–1.999	1	..	..	..	..	..	..	..	..	..	1	..
2.000–2.499	2	..	..	..	..	..	..	1	..	..	..	..
2.500–2.999	2	3	4	1	1	..	..	1	..	1	1	..
3.000–3.499	6	5	10	7	3	3	3	3	3	1	5	2
3.500–3.999	9	9	19	12	13	4	10	4	5	6	14	13
4.000–4.499	14	9	24	8	17	8	17	18	29	20	80	37
4.500–4.999	6	10	17	6	7	3	13	7	22	7	47	24
5.000–5.499	2	2	3	1	3	2	2	3	3	3	6	..
5.500–5.999	..	..	..	..	..	..	1	..	..	2	..	..
6.000–6.499	..	..	..	1	..	..	..	..	..	..	..	..
Totals.....	42	38	77	33	48	19	46	37	62	40	154	76
Mean.....	3.893	4.066	4.038	4.085	4.073	4.118	4.294	4.196	4.387	4.350	4.338	4.206
S. D.	774	672	610	670	572	535	490	635	430	584	467	383
P. E. of mean	80	70	50	60	60	80	50	60	40	60	30	30
Hemoglobin, per Cent												
30 – 34	3	5	3	1	2	..	..	2	..	..	1	..
35 – 39	5	5	5	4	4	1	..	..	..	..	1	..
40 – 44	3	1	9	3	6	1	7	2	..	2	2	2
45 – 49	7	3	9	1	3	2	3	2	..	1	2	1
50 – 54	2	4	10	5	1	2	2	3	4	1	7	2
55 – 59	4	5	8	5	6	2	8	5	2	4	..	3
60 – 64	9	1	7	7	3	3	6	6	2	4	5	6
65 – 69	2	5	11	4	6	1	2	7	10	6	12	6
70 – 74	7	13	13	7	13	3	11	13	27	17	60	36
75 – 79	11	3	15	8	3	4	16	4	23	7	52	20
80 – 84	6	3	5	2	2	4	6	6	5	5	12	2
85 – 89	2	2	4	3	3	2	3	3	..	2	3	..
90 – 94	1	..	..	..	..	..	..	..	..	1	1	..
95 – 99	1	..	..	1	..	..	1	..	..	..	..	..
Totals.....	63	50	99	51	52	25	66	53	73	50	158	78
Mean.....	63.5	60.6	61.9	64.1	61.6	67.3	67.2	67.0	72.3	70.5	72.6	70.7
S. D.	16.8	16.5	14.9	15.2	15.4	15.3	14.5	13.1	7.0	10.6	9.1	8.3
P. E. of mean	1.4	1.6	1.0	1.4	1.4	2.1	1.2	1.2	0.6	1.0	0.5	0.6

* In this table and in tables 2, 3 and 5, S. D. means standard deviation; P. E., probable error.

arguments on the gradation in the averages of the red cell counts, which parallel those of the hemoglobin readings, and which doubtless have a high degree of accuracy because they are based on the reports of well trained technicians, experts in the use of an instrument of considerable precision. Finally, it can be shown mathematically by a study of the "probable errors" that the chances are 1,500 to 1 that the gradation in the average red cell count depicted in chart 1 is significant.

TABLE 2.—*Percentage Distributions of Hemoglobin with Carcinoma in Different Parts of the Colon* *

Hemoglobin, per Cent	Cecum		Ascending Colon and Hepatic Flexure		Transverse Colon		Descending Colon and Splenic Flexure		Sigmoid		Rectum		Total Right Colon		Total Left Colon		Total Colon	
	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
20–24	..	...	..	...	..	...	1	0.8	..	...	..	...	..	...	1	0.2	1	0.1
30–34	8	7.1	4	2.7	2	2.6	2	1.7	..	...	1	0.4	12	4.6	3	0.6	17	2.1
35–39	10	8.9	9	6.0	5	6.5	..	...	..	...	1	0.4	19	7.2	1	0.2	25	3.1
40–44	4	3.5	12	8.0	7	9.1	9	7.6	2	1.6	4	1.7	16	6.1	15	3.1	38	4.6
45–49	10	8.9	10	6.7	5	6.5	5	4.2	1	0.8	3	1.3	20	7.6	9	1.9	34	4.2
50–54	6	5.3	15	10.0	3	3.9	5	4.2	5	4.1	9	3.8	21	8.0	19	4.0	43	5.3
55–59	9	8.0	13	8.7	8	9.6	13	10.9	6	4.9	3	1.3	22	8.4	22	4.1	52	6.4
60–64	10	8.9	14	9.3	6	7.8	12	10.1	6	4.9	11	4.7	24	9.1	29	6.1	59	7.2
65–69	7	6.2	15	10.0	7	9.1	9	7.6	16	13.0	18	7.6	22	8.4	43	9.0	72	8.8
70–74	20	17.7	20	13.3	16	20.8	24	20.2	44	35.8	96	40.6	40	15.2	164	34.3	220	23.9
75–79	14	12.4	23	15.3	7	9.1	20	16.8	30	24.4	72	30.5	37	14.1	122	25.5	163	20.3
80–84	9	8.0	7	4.7	6	7.8	12	10.1	10	8.1	14	5.9	16	6.1	36	7.5	58	7.1
85–89	4	3.5	7	4.7	5	6.5	6	5.0	2	1.6	3	1.3	11	4.2	11	2.3	27	3.3
90–94	1	0.9	..	...	..	...	..	...	1	0.8	1	0.4	1	0.4	2	0.4	3	0.4
95–99	1	0.9	1	0.7	..	...	1	0.8	..	...	..	...	2	0.8	1	0.2	3	0.4
Total	113		150		77		119		123		236		263		478		818	
Mean		62.2		62.6		63.4		67.1		71.5		71.9		62.5		70.6		67.3
S. D.		16.7		15.1		15.4		13.8		8.8		8.7		15.8		10.6		13.5
P. E. of the mean		1.1		0.8		1.2		0.9		0.5		0.4		0.7		0.3		0.3
Mean duration of symptoms, months		11.4		11.7		11.0		8.0		10.0		10.5						
P. E. of duration, days		27		30		30		25		27		20						
Loss of weight, pounds		24.4		25.6		22.7		24.5		17.8		16.7						
P. E. of loss of weight, pounds		0.7		0.8		1.0		0.9		0.7		0.1						

* The total number of cases of carcinoma of the colon, 818, is larger than the sum of 263 and 478 because it includes the seventy-seven cases of cancer of the transverse colon. Other discrepancies in totals are due to the fact that complete blood studies were not made in all the cases; hence, some were used for the hemoglobin averages, some for red cell averages, and some for both.

During the course of the work we analyzed records from 1,168 cases of carcinoma of the colon, forty of the small intestine, 203 of the stomach, 130 of the breast, and 144 of the uterus, all removed at operation and studied microscopically.

TABLE 3.—*Percentage Distributions of Hemoglobin with Carcinoma of the Stomach, Small Intestine, Uterus and Breast and Tuberculosis of the Cecum*

Hemoglobin, per Cent	Carcinoma of the Stomach						Carcinoma of the Small Intestine		Carcinoma of the Uterus						Carcinoma of the Breast		Tuberculosis of the Cecum	
	Pyloric End		Body		Total				Fundus				Cervix					
									Without Bleeding		Profuse Bleeding		Without Bleeding		Profuse Bleeding			
	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
20–24	..	...	..	...	..	...	1	2.5	..	...	..	...	..	...	..	...	..	...	..	...
25–29	2	2.9	1	0.7	3	1.5	..	...	..	...	..	...	..	...	..	...	..	...	..	...
30–34	3	4.5	6	1.5	9	4.4	..	...	..	...	1	3.7	..	...	..	...	..	...	..	...
35–39	3	4.5	7	5.1	10	4.4	1	2.5	..	...	2	7.4	..	...	4	20.0	..	...	..	...
40–44	1	1.5	10	7.4	11	5.4	1	2.5	..	...	2	7.4	..	...	1	5.0	..	...	..	...
45–49	3	4.5	5	3.7	8	3.9	4	10.0	..	...	1	3.7	..	...	..	...	.	...	..	...
50–54	2	2.9	7	5.1	9	4.4	3	7.5	1	1.8	3	11.1	..	...	..	...	..	...	..	...
55–59	3	4.5	6	4.4	9	4.4	4	10.0	3	5.5	1	3.7	..	...	2	10.0	..	...	..	...
60–64	3	4.5	11	8.1	14	6.9	3	7.5	..	...	3	11.1	1	3.8	2	10.0	4	3.1	1	5.3
65–69	5	7.5	14	10.3	19	9.4	4	10.0	1	1.8	6	22.2	1	3.8	2	10.0	4	3.1	3	15.8
70–74	24	35.8	36	26.4	60	29.5	4	10.0	22	40.0	1	3.7	6	23.1	1	5.0	70	53.8	7	36.8
75–79	13	19.4	22	16.2	35	17.2	9	22.5	18	32.8	6	22.2	4	15.4	3	15.0	44	33.8	5	26.3
80–84	3	4.5	8	5.9	11	5.4	6	15.0	8	14.5	1	3.7	9	34.6	4	20.0	7	5.4	2	10.5
85–89	2	2.9	2	1.5	4	2.0	..	...	2	3.6	..	...	4	15.4	1	5.0	1	0.8	1	5.3
90–94	..	...	1	0.7	1	0.5	..	...	..	...	..	...	1	3.8	..	...	..	...	..	...
Total	67		136		203		40		55		27		26		20		130		19	
Mean		66.0		64.2		64.8		65.5		79.9		61.8		79.2		64.5		74.4		74.3
S. D.		15.2		15.1		12.5		14.5		6.7		14.2		6.9		17.2		4.0		5.9
P. E. of mean		1.2		0.9		0.6		1.5		0.6		1.8		0.9		2.6		0.2		0.9
Mean duration of symptoms, months		8.4		8.4		8.4		7.7												
P. E. of duration, days		26		18		15		23												

INTERPRETATION OF DATA

The next question is, What interpretation can be placed on the figures that we have obtained? Assuming that the degree of anemia is dependent largely on the duration of the illness, on the amount of weight lost, on the presence or absence of metastasis, and perhaps on

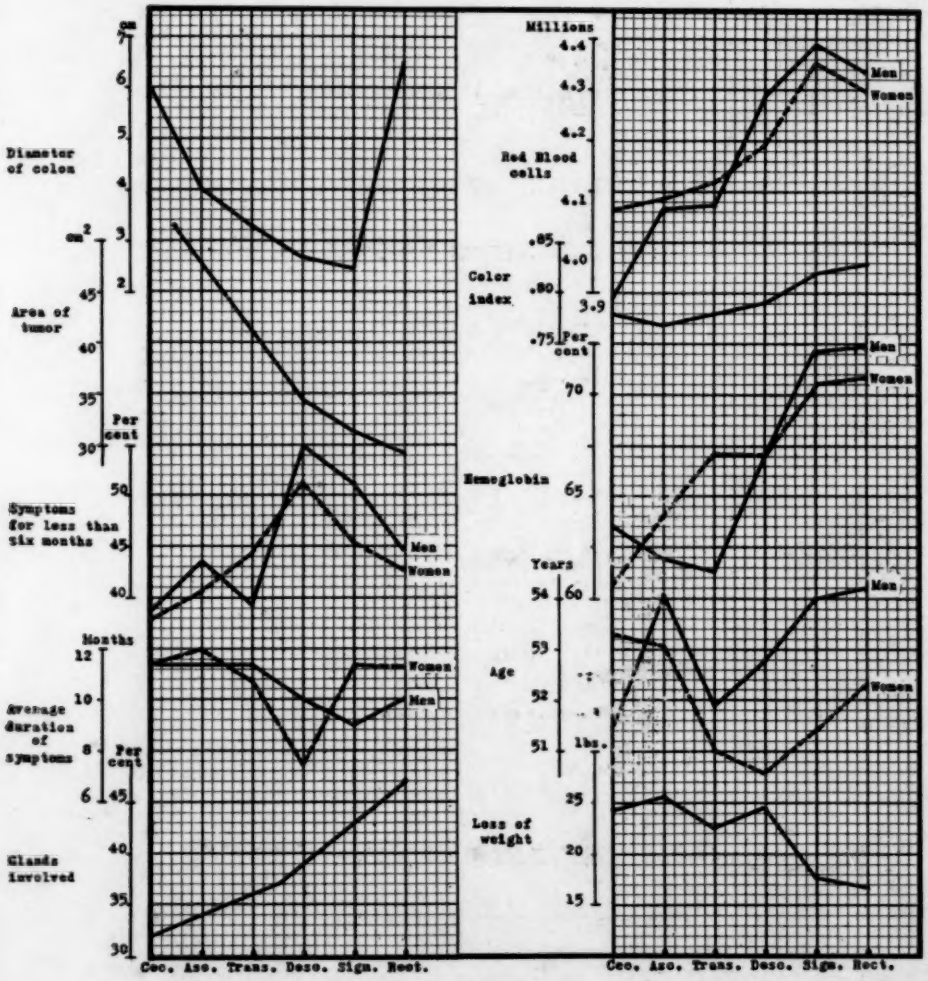

Chart 1.—Gradation in several of the groups of data given in the text; the abscissas indicate the different regions from one end of the colon to the other.

the age of the patient, might not the differences which we have found be due simply to an unequal distribution in the two groups, of persons who have lost weight, who are old, or who have older and more extensive lesions?

In working out the answer to this question, our first move was to see if the factors just mentioned really do have any influence on the production of anemia, because if they do not, they can be disregarded and the problem will be greatly simplified. We took, therefore, all cases of men and women with cancers in any part of the colon, and calculated,

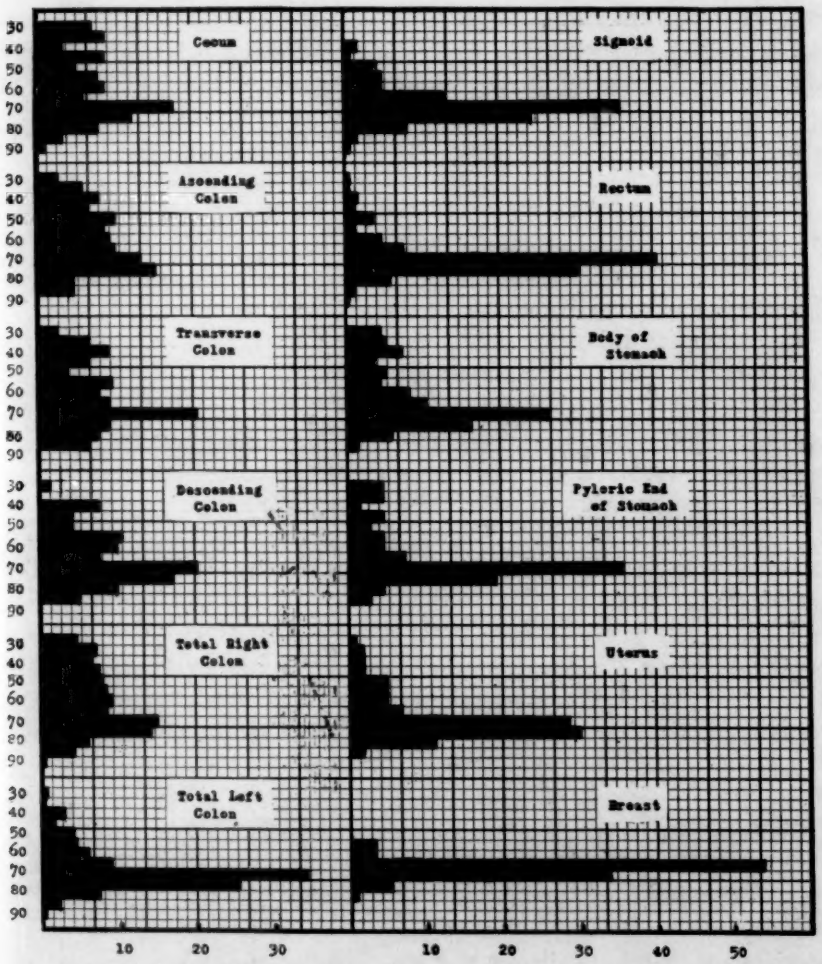

Chart 2.—Distribution of patients with low and high hemoglobin readings with cancer in different parts of the colon, and in the stomach, uterus and breast; the abscissas represent percentages of the patients in individual groups and the ordinates represent hemoglobin readings with the Dare instrument.

first, the correlation coefficient between the red cell count and the duration of symptoms. The figure obtained was —0.157 ±0.024, which means that there is a slight tendency for the count to decrease as the duration of symptoms increases. If the size of the count had always

been inversely proportional to the duration of the symptoms, this figure would have been —1, and if there had been absolutely no correlation between them, it would have been zero. The coefficient between percentage of hemoglobin and duration of symptoms was —0.131 ±0.039 for tumors of the right side of the colon, and —0.081 ± 0.063 for tumors of the left side. As will be seen later, this absence of correlation observed with tumors on the left side is probably due to the fact that the first symptoms are likely to be those of obstruction, while with tumors on the right side, obstruction comes later, and there is time for the development of anemia, the severity of which will be somewhat related to the duration of the symptoms.

The coefficient between the red cell count and the amount of weight lost was 0.153 ±0.026. For cell count and age, the coefficient was 0.028 ± 0.035, which shows that there is no relation. Strange to say, there was no relation between duration of symptoms and loss of weight, the factor being 0.047 ±0.030. As will be seen later, the main reason for this is probably that the duration of symptoms is a poor index to the age of the tumor.

With such low correlation coefficients we can now say that no allowance need be made for differences in the ages of the patients or in the amount of weight lost. This is all the more true because, as may be seen from chart 1, these two factors vary little anyway. The only significant difference is found with tumors of the sigmoid and rectum in which the loss of weight is not so great as with tumors in the rest of the colon.

Unfortunately, we cannot put much confidence in the coefficient for the duration of symptoms and degree of anemia, because it is certain that the onset of symptoms marks, not the beginning of cancerous growth, which is really what we would like to determine, but the time when the mass has developed to a point where it can interfere with the passage of fecal material through the bowel. This feature will be discussed later in more detail.

COMPARATIVE MALIGNANCY

When confronted with the differences in the production of anemia associated with tumors in the various parts of the colon, one of the first things to be thought of is a corresponding and underlying difference in the extent of metastasis. A little study showed, however, that even if such a difference were present, it could not account for the gradation in anemia, because in patients still suitable for operation—the type that we have studied—the spreading of the growth has little influence on the blood, and the difference in the production of anemia with tumors in the right and left halves of the colon can be shown just as well in the group without metastasis as in the group with it (table 4).

Even with this proof the thought remained in our minds that tumors of the right side of the colon might still in some way have a greater malignancy; so we turned to the careful investigation of this subject carried out by Craig and MacCarty,[2] Hayes[3] and McVay.[4] They picked off and studied microscopically the glands removed with 300 segments of the colon resected for cancer, and found a gradation in the tendency of these tumors to metastasize, but it was just opposite to that which would be needed to explain the gradation in the production of anemia. There was more or less involvement of the regional glands in 47 per cent of the rectal and in 32 per cent of the cecal cases, and a fairly even gradation in metastasis with the tumors situated in the regions between.

The high degree of anemia with colonic cancers can hardly be ascribed to a high degree of malignancy, because it is well known that such tumors are generally of low malignancy, and that they metastasize

TABLE 4.—*Influence of Metastasis on the Red Cell Counts and Hemoglobin Readings*

	Carcinoma Without Metastasis				Carcinoma With Metastases			
	Cases	Right Colon	Cases	Left Colon	Cases	Right Colon	Cases	Left Colon
Red cells, millions.....	195	4.042 ± 0.03	426	4.339 ± 0.02	40	3.875 ± 0.07	75	4.243 ± 0.04
Hemoglobin, per cent..	272	62.3 ± 0.70	496	70.7 ± 0.30	49	61.7 ± 1.6	84	69.0 ± 0.80

slowly as compared with those in the stomach. With gastric cancers MacCarty and Blackford[5] found involvement of the regional glands in fifty-two of one hundred cases studied.

HEMORRHAGE

The gradation in the production of anemia in cases of carcinoma of the colon might easily be explained if it could be shown that there is a greater tendency to hemorrhage with tumors on the right side, but a review of a number of the histories showed that few of the patients with cancer anywhere in the colon complained much about bleeding. Many had not seen blood at all and when it had been noticed it was only at long intervals in the course of the illness.

2. Craig, W. M., and MacCarty, W. C.: Involvement of the Lymph Glands in Cancer of the Cecum, Ann. Surg. **77**:698-710 (June) 1923.

3. Hayes, J. M.: The Involvement of the Lymph Glands in Carcinoma of the Large Intestine, Minnesota Med. **4**:653-663 (Nov.) 1921.

4. McVay, J. R.: Involvement of Lymph Nodes in Carcinoma of the Rectum, Ann. Surg. **76**:755-767 (Dec.) 1922.

5. MacCarty, W. C., and Blackford, J. M.: Involvement of Regional Lymphatic Glands in Carcinoma of the Stomach; from a Study of 200 Resected Specimens, Ann. Surg. **55**:811-843, 1912.

THE GRADATION IN THE DIAMETER OF THE BOWEL

The most probable cause for the gradation in anemia seems to be the gradation in the diameter of the bowel. On measuring a few roentgenograms of the colon, we found that the diameter of the cecum is about 6 cm.; that of the ascending colon, 4 cm.; of the transverse colon, 3.3 cm.; of the descending colon, 2.7 cm.; of the sigmoid, 2.5 cm., and of the rectum, 6.5 cm. As has already been pointed out, the first symptoms of cancer of the colon are ordinarily those of obstruction; in other words, the tumor generally grows silently until it becomes large enough to interfere with the passage of the fecal material. Under those circumstances one should expect the size of the tumors to be graded from the descending colon to the cecum because the onset of urgent symptoms would mean simply that a certain proportion of the lumen had become blocked. A tumor the size of a walnut, which would produce serious symptoms if situated in the descending colon, would pass unnoticed in the cecum, while a tumor as large as the palm of the hand, which might cause some pain and anemia in the cecum, would be incompatible with life if transplanted to the descending colon.

Furthermore, the cecum would be more likely to tolerate a large tumor because its contents are fairly liquid and more likely to slip past a growing obstruction. An exception to this rule must, of course, be made for those growths which begin near the ileocecal sphincter. They soon cause obstruction in the small intestine, and they act more like ileal than cecal tumors. In one such case in which the sphincter alone was affected, death followed a stormy illness of only six months' duration.

GRADATION IN THE SIZE OF THE TUMORS

If the foregoing argument is correct, there should be a gradation in the size of the tumors in the different parts of the bowel and, as may be seen in table 5 and chart 1, that is just what was found. The surface areas of the tumors in square centimeters ranged from 51.6 $\pm$2.0 in the cecum to 29.1 $\pm$1.3 in the rectum. The only difficulty that remains is that, according to our theory, the rectum, with its large diameter, should have tumors larger than those in the descending colon. Actually, they averaged a little smaller, but this need not disturb us greatly because a number of facts have appeared during this analysis, all suggesting that cancers of the rectum, and perhaps of the sigmoid, should be studied under a separate classification, apart from those in the rest of the colon. This may be due to differences in the structure of that part of the tube, to differences in its relation to surrounding organs, to the special nerve supply, and to its nearness to the outside of the body, which probably causes such symptoms as the discharge of blood and pus to be observed earlier than they would be if the tumor were higher up.

DURATION OF SYMPTOMS

If our theory is correct there should also be a gradation in the duration of symptoms because with tumors of the left side of the colon obstruction should appear early; the symptoms should be acute and urgent, and the patient should be driven to seek relief early. With tumors of the cecum, not involving the ileocecal sphincter, obstruction should come late, and there should be more time for the development of symptoms such as indigestion, weakness and anemia, all of which the patient might be able to neglect for a while.

Actually, while 54 per cent of the patients with cancer of the narrow descending colon felt sick enough to come to the clinic within

TABLE 5.—*Area of Resected Tumors*

	Cecum and Ascending Colon		Transverse Colon		Descending Colon		Sigmoid and Recto-sigmoid		Rectum		Stomach	
Area in Sq. Cm.	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
Up to 10.....	6	5.7	3	8.4	3	10.0	10	14.7	8	9.0	24	24.0
11 - 20.....	10	9.4	8	22.2	6	20.0	16	23.5	27	30.3	22	22.0
21 - 30.....	16	15.1	5	13.9	6	20.0	13	19.1	16	18.0	20	20.0
31 - 40.....	15	14.1	6	16.7	3	10.0	8	11.8	21	23.6	7	7.0
41 - 50.....	18	17.0	3	8.4	3	10.0	7	10.3	8	9.0	3	3.0
51 - 60.....	7	6.6	4	11.2	5	16.7	5	7.4	2	2.2	6	6.0
61 - 70.....	8	7.5	1	2.8	3	10.0	4	5.9	4	4.5	9	9.0
71 - 80.....	6	5.7	2	5.6	1	3.3	4	5.9	2	2.2	1	1.0
81 - 90.....	6	5.7	1	2.8	..	....	1	1.5	..	....	2	2.0
91 -100.....	4	3.8	..	....	..	....	..	....	..	....	4	4.0
101 -110.....	2	1.9	1	2.8	..	....	..	....	..	....	..	....
111 -120.....	1	0.9	1	2.8	..	....	..	....	1	1.1	..	....
121 -130.....	4	3.8	1	2.8	..	....	..	....	..	....	1	1.0
131 -140.....	1	0.9	..	....	..	....	..	....	..	....	..	....
141 -150.....	1	0.9	..	....	..	....	..	....	..	....	..	....
151 -160.....	..	....	..	....	..	....	..	....	..	....	1	1.0
161 -170.....	1	0.9	..	....	..	....	..	....	..	....	..	....
Total.....	106		36		30		68		89		100	
Mean.....		51.6		41.3		34.7		31.2		29.1		31.5
S. D.		31.0		30.0		20.2		21.0		18.5		29.2
P. E. of mean...		2.0		3.4		2.5		1.7		1.3		2.0

six months after the appearance of definite symptoms, only 35 per cent of those with cancer of the cecum were similarly forced to seek relief.

The gradation in the figures for the average duration of symptoms with tumors in the different parts of the bowel is not so marked. Furthermore, the data are somewhat inaccurate because we do not know what trust to put in the statements of some patients that they had had symptoms for five or six years or more. We suspect that in many instances the earlier symptoms were due to other causes, such as cholecystitis. Thus, in two cases the patients gave clear-cut histories of cramplike pains and what seemed to have been attacks of mild intestinal obstruction recurring at intervals for twelve and fifteen years, respectively. The fact that in both of these cases the patients continued to suffer with the same type of pain after the removal of a cancer of the colon indicates that it was due to disease of the gallbladder, which

was found at the time of operation. In other cases the disappearance after operation of symptoms of indigestion which had been present for years left us with the strong impression that the tumor either must have existed for a long time or had developed in an old stricture, polyp or diverticulum. Actually, in a few cases a primary polyp or diverticulum could still be identified at the time of operation. As we did not feel justified in using the twelve and fifteen-year histories in making the averages, and as a line had to be drawn somewhere, we put it at six years.

CANCER OF THE SMALL INTESTINE

As was to be expected from our hypothesis, cancer in the narrow and more irritable small bowel produced urgent symptoms even more promptly than in the descending colon, and 64 per cent of the patients seen at the Mayo Clinic with such growths applied for relief within six months after the onset of the trouble. The average duration of the illness was 7.7 $\pm$0.9 months, and none of the patients had symptoms for more than three years.

MODE OF ACTION OF THE TUMOR ON THE BLOOD

It appears, then, that the graded difference in the production of anemia is associated with a gradation in the size and age of the tumors which, again, is due to a gradation in the diameter of the colon. As the regression seemed to be nonlinear, on Dr. Dunn's advice, we divided the correlation table into two parts, the first one including cases with hemoglobin contents up to 50 per cent and the other with hemoglobin over 50 per cent. In the first group the correlation factor was —0.485 $\pm$ 0.01, and in the second it was —0.319 $\pm$ .073. These coefficients are definite and twice as large as any of the other coefficients that we have computed.

The next question is, How does the tumor act on the blood? Does it elaborate hemotoxins; does it destroy a particularly important area of the mucous membrane of the bowel; does it act by producing obstruction, or does it act by producing a large ulcerated surface from which the body can lose blood and other poorly replaceable fluids and through which it can absorb bacterial poisons?

In order, first, to study the influence of cancer alone, without the complication of a bleeding, oozing and infected surface, we analyzed the records of 130 patients with nonulcerating cancer of the breast, operated on at the clinic. The hemoglobin readings were practically normal for the Dare instrument, and the average was 74.4 $\pm$ 0.2 per cent. The average red cell count was 4,410,000 $\pm$ 20,000 (chart 2). The tumors ranged in size from 5 to 90 sq. cm., with an average of 8.4 $\pm$ 0.6 sq. cm. There was absolutely no correlation between the size of the

tumor and the hemoglobin reading, but this may not mean much because most of the tumors were apparently too small to have any effect on the blood.

Similarly, the average hemoglobin reading in fifty-five women with carcinoma of the fundus of the uterus not associated with profuse bleeding was 74.9 ± 0.6 per cent. All but 10 per cent of these women had hemoglobin readings over 70 per cent. Twenty-seven women with the same type of cancer in the fundus but with considerable bleeding had an average hemoglobin of 61.8 ±1.8 per cent, which shows how important the factor of hemorrhage is. Similarly, twenty-six women with cancer of the cervix without much hemorrhage had an average hemoglobin of 79.2 ±0.9 per cent, while twenty women with the same type of cancer and with hemorrhage had an average of 64.5 ± 2.6.

The inability of carcinomatous tissue alone, with little or no ulcerated surface, to lower the amount of hemoglobin in the body was shown in a number of cases in which the condition of the blood returned almost to normal in spite of the fact that a large cancer of the bowel had been short-circuited and left. In one such case the patient returned with a big brawny mass involving the anterior abdominal wall, and yet the hemoglobin reading was considerably higher than it had been a year before when she came with a small napkin-ring-type of growth. In another case, a woman with a small carcinomatous ulcer of the rectum had a liver so full of metastatic nodules that it reached to her umbilicus and, at necropsy, weighed 5,600 Gm. The hemoglobin reading was 67 per cent. We must conclude, therefore, that the mass of the cancer cells is not the important factor in producing anemia.

THE CECUM NOT ESSENTIAL

If there were something peculiar about the cecal mucous membrane which makes it essential to the body, we should expect the anemia to persist or get worse after excision of the right half of the colon. Actually, a review of thirteen cases of cancer of the cecum in which excision was done with complete or considerable success shows that in every instance there was almost immediate improvement in the condition of the blood, in the body weight, and in the general sense of well-being. The hemoglobin reading generally remained between 70 and 80, and the red cell count around 4,500,000, which is about normal for men and women of cancer age. Lemon [6] has shown also that extensive destruction of the ileocecal region by tuberculosis ordinarily does not damage the blood much. The average hemoglobin reading in his series was 70 per cent. We made a particular study of nineteen cases in

6. Lemon, W. S.: Intestinal Tuberculosis: III. Clinical Studies Relating to Diagnosis, Nat. Tuberc. Assn. Tr. **21**:186-199, 1925.

which there was little pulmonary involvement but a great deal of change in the cecum, and found an average hemoglobin reading of 74.3 ±0.9 per cent.

All this evidence makes it appear improbable, then, that there is any function of the cecal mucous membrane which is essential to the maintenance of normal conditions in the blood. It does not, of course, rule out such a possibility, and we do not feel like putting aside lightly the clinical impressions of men of enormous experience. It should be noted, however, that if we ascribe such peculiarities to the mucous membrane of the cecum, we may with perhaps greater propriety ascribe them to the mucous membrane of the stomach, where the degrees of anemia produced by small tumors almost equal those produced in the cecum by very large ones.

THE FACTOR OF OBSTRUCTION

The striking improvement in the condition of the blood and general health which occurs in many cases after the removal or short-circuiting of narrow "napkin-ring" tumors of the transverse and descending colon makes it appear as if obstruction of the bowel must play a large part in lowering the vitality of the body. The same type of improvement is seen also after the short-circuiting of noncancerous lesions of the bowel. We noted one case of a young man aged 23 who had had severe indigestion and abdominal pain for two years. The hemoglobin reading was 65 and the red cell count was 3,830,000. Two months later, after a large inflammatory mass in the cecum had been short-circuited, the hemoglobin percentage had risen to 72 and the red cell count to 4,720,000. In another case a big tuberculous mass involving the cecum was short-circuited and left. Two years later the hemoglobin reading was 72 per cent and the red cell count was 4,780,000. In these cases there is generally a good deal of shrinkage in the tumor immediately after the operation, but that can hardly account for all the improvement.

Against the idea that chronic obstruction is largely responsible for the anemia is the finding of normal hemoglobin and a normal blood count in the case of the woman already mentioned who had suffered for six months with symptoms of obstruction so fulminant that she finally died in one of the attacks before she could be operated on. In this case the effect of obstruction could be studied almost by itself because the growth was a small one limited sharply to the region of the ileocecal valve.

THE IMPORTANT FACTORS IN THE PRODUCTION OF ANEMIA

One thing we can say, and that is that the passage of feces over the tumor, whether cancerous or tuberculous, has a great deal to do with the production of anemia and cachexia. And that leads up to our final

conclusion, which is that the important factor in the production of anemia is the presence of a large ulcerated area from which blood can ooze and through which bacteria can enter.

It has already been pointed out that cancers of the cecum are generally very large; 9.3 per cent have areas of from 100 to 170 sq. cm. (table 3). It seems probable, therefore, that the main reason for their unique action on the blood is to be found in their unique size. Certainly, nowhere else on the inner surface of the body can cancers be found with such large ulcerated areas. Judging from its large capacity, one would expect to find the largest cancers in the stomach, but this is not the case. As can be seen on turning again to table 4, two-thirds of the carcinomas of the stomach measured by MacCarty and his associates had areas of less than 30 sq. cm. and the mean was 31.5 ± 2.0 sq. cm. We find, then, that they were smaller even than the cancers in the decending colon. The reason for it is probably that the stomach is more sensitive than the colon; symptoms appear earlier, and particularly when the pylorus is affected, the patient is driven to seek relief before the tumor has had time to become very large.

Another important point about the cecal tumors is that their ulcerated surface is exposed to the most concentrated culture of organisms which can be found anywhere in the body. Many of them are highly pathogenic, and some, like *Bacillus Welchii* and *Bacillus coli,* have long been suspected of having something to do with the production of severe anemia. Perhaps the main reason for the marked improvement in body weight, in general health, and in the blood picture after short-circuiting operations is to be found in the drying out of the fecal material left around the growth, and with that, a lowering in the numbers and virulence of the organisms.

Short-circuiting also removes pressure from the bowel and probably cuts down on the amount of what Adami has called subinfection; that is, the passage of intestinal bacteria into the lymphatics and into the blood stream. It may be that the lesser degree of anemia seen with tumors of the left half of the colon is due partly to the fact that in this region the feces are usually hard and dry, and the bacteria for the most part dead. Under those circumstances, the factor of infection should be less important than it is with the cecal tumors.

One objection to our theory of the causation of anemia is that the blood remains in fairly good condition in most of the uncomplicated cases of tuberculosis of the cecum, even when the ulcerated area is fairly large. It is probable, however, that there is more oozing of blood from the fungating, friable surface of the carcinomatous type of lesion, and perhaps a better chance for the penetration of bacteria. Severe grades of anemia were seen in a few cases of tuberculosis of the cecum in

which the disease either was extensive, reaching into the first part of the transverse colon, or else associated with considerable hemorrhage.

SUMMARY

Carcinoma of the cecum and ascending colon has a marked tendency to produce severe grades of anemia. This tendency is progressively less marked with cancers of the transverse, the descending, and the pelvic portions of the colon.

The gradation cannot be explained on the basis of a greater loss of weight, more severe hemorrhage, or greater malignancy of the tumors in the right half of the colon. The malignancy of colonic cancers as a whole is low as compared with that of gastric cancers, and the tendency to metastasize is greater with cancer of the rectum than with that of the cecum.

The cause for the gradation in anemia seems to be a gradation in the surface area of the tumors, from an average of 51.6 ± 2.0 sq. cm. in the cecum to 31.2 ± 1.7 sq. cm. in the sigmoid. This gradation is dependent, again, on a gradation in the diameter of the colon from about 6 cm. in the cecum to 2.5 cm. in the sigmoid. The patient seeks relief when the lumen of the bowel becomes more or less blocked. In the descending colon this can happen when the tumor has grown to the size of a walnut; in the cecum it does not happen until the mass is as large as a man's hand.

As would be expected, then, the patients with cancers in the narrow descending colon are driven to seek relief early, usually within six months after the onset of the trouble. The symptoms with cancer of the cecum are less urgent and the sufferers often put off consulting a physician until they are markedly anemic.

There is a definite relation between the area of the tumor removed at operation and the degree of anemia.

The cancer cells alone do not seem to have much effect on the blood, as shown by the fact that nonulcerating carcinoma of the breast or fundus of the uterus is seldom associated with anemia; that the blood of patients with large cancers of the bowel which have been short-circuited and left often returns for a while almost to normal, and that patients with insignificant cancers of the bowel and enormous masses of cancer tissue in the liver show only moderate grades of anemia.

The anemia with cancer of the cecum cannot be ascribed to the loss of an essential mucous membrane or function because the blood picture usually reverts almost to normal after that part of the bowel has been short-circuited or removed. Furthermore, its destruction by tuberculosis is ordinarily not associated with much anemia.

The essential factor in the production of anemia seems to be the presence of a large ulcerated area from which blood can ooze and through which bacteria can enter. Nowhere else on the inside of the body can ulcerating cancers be found so large as in the cecum, and nowhere else are such big, raw surfaces in contact with a concentrated culture of organisms, many of them virulent, and when injected into animals, capable of producing severe anemia.

These observations emphasize the necessity for looking particularly at the cecum when a patient presents himself with marked secondary anemia and few symptoms to point to the source of the trouble. It should be remembered also that with carcinoma of the colon, the presence of marked anemia is not the same contraindication to operation which it is in the case of carcinoma of the stomach.

PORTAL CIRRHOSIS WITH ASCITES AND ITS SURGICAL TREATMENT

A REVIEW OF TWENTY-SIX CASES *

WALTER HUGHSON, M.D.
BALTIMORE

Few diseases approached from a surgical standpoint offer so many interesting possibilities for individual ingenuity and at the same time oppose so many difficulties to rational treatment as does portal cirrhosis with ascites. The stage of the disease under discussion in most instances probably is the last stage, and the surgeon's efforts are directed toward the correction of this particular manifestation, though he is not given an opportunity to affect the disease itself. The literature on the subject is remarkably voluminous when one considers the comparative rarity of the condition and also the fairly brief period—now thirty years—during which surgical operation has been used as a method of treatment. Isolated reports of cases in which treatment consisted of the various surgical procedures available appear with considerable regularity, and in the main these reports seem to indicate a certain justification for surgical intervention. In view of the human tendency to announce or at least to emphasize only favorable results, a moderate degree of skepticism might temper somewhat the first feeling of optimism. There can be little doubt that the situation is not entirely satisfactory from a surgical standpoint. Cures, as estimated by the permanent disappearance of fluid, are certainly infrequent, and the surgeon who can report definite improvement in a number of cases may regard himself as fortunate.

Were the diagnosis of portal cirrhosis a simple matter, statistics as to the results of surgical treatment would be of much greater value than they are at present. Surprisingly little attention is paid to this important phase of the subject. Direct inspection of a liver may tend to confirm the belief that cirrhosis does exist, but such evidence is by no means conclusive. Microscopic examination of a biopsy specimen is the only method by which an absolute diagnosis can be made during life. In only one report reviewed by the author has such positive evidence been recorded on microscopic examination. Even autopsy observations are seldom tabulated in support of a clinical diagnosis. Great confusion seems also to exist in the classification of cirrhoses of the liver. Cirrhosis is a general disease of which there are many distinct varieties. A definite etiology can be ascribed to some types but not to others.

* From the Surgical Department of Johns Hopkins University and Hospital.

There should be no uncertainty as to the type for which surgical procedures may be used with some hope of success. Further emphasis will be placed on this particular point in the discussion of the cases herewith reported.

Though this particular type of cirrhosis is described in all textbooks and in many special articles on the subject, for the sake of clarity a brief statement of the pathology, etiology, diagnosis and methods of medical treatment will be presented. I shall not attempt to offer a complete review of the literature, as several monumental articles are already available, notably that of Höpfner.[1] Though such compilations serve an extremely useful purpose in the matter of reference, they tend somewhat to confuse further an already uncertain situation.

DEFINITION OF TERM PORTAL CIRRHOSIS

Portal cirrhosis as defined in Osler's [2] "System of Medicine" is a "chronic degenerative and inflammatory disease of the liver characterized by recurring degeneration and regeneration of the hepatic parenchyma and by concomitant and consecutive fibrosis in and about the interlobular or portal spaces, all of which leads ultimately to obstruction of the portal circulation." In Barker's [3] "The Clinical Diagnosis of Internal Diseases," volume 2, the following statement is made in reference to portal cirrhosis of the liver:

> Under this heading I shall include (1) *ordinary portal cirrhosis* (the so-called *atrophic cirrhosis* of Laënnec); (2) *Banti's disease,* or cirrhosis with splenomegaly; (3) the cirrhosis of *hemachromatosis;* and (4) *Wilson's disease,* or cirrhosis of the liver with progressive degeneration of the nucleus lentiformis.
>
> In all forms of portal cirrhosis, chronic degenerative and inflammatory changes occur in the liver, the connective tissue developing about the interlobular or portal spaces, and leading finally to obstruction of the vena porta, with the development of collateral circulations between the vena porta and the superior and inferior caval veins.

In the present discussion I am concerned principally with the type of cirrhosis described by Barker as "ordinary portal cirrhosis of the liver." It seems to be a mistake to include Banti's disease, by reason of the difference found here in the indications for operation. These are reported, however, particularly in the considerable series from the Mayo Clinic. The cirrhoses of hemachromatosis and Wilson's disease are of such rarity that they need scarcely be considered.

---

1. Höpfner, E.: Der Ascites und seine chirurgische Behandlung, Ergebn. d. Chir. u. Orthop. **6**:410, 1913.

2. Osler, W.: Modern Medicine, Philadelphia, Lea & Febiger, 1925, vol. 5, p. 759.

3. Barker, L. F.: The Clinical Diagnosis of Internal Disease, New York, D. Appleton & Co., vol. 2, p. 639.

ETIOLOGY

As is true of so many diseases which are primarily medical and later become surgical for the relief of some particular symptom, physicians are completely in the dark as to the true etiology of portal cirrhosis. With the advance made in medicine and pathology during the past two decades, the originally assigned cause, alcoholism, has fallen into the discard. The familiar term "gin-drinker's liver" was of much greater significance from an etiologic standpoint than "cirrhosis hepatis." A few of the older pathologists still cling to this idea, and recent statistical studies indicate that the incidence of portal cirrhosis appears to be on the decline in certain European countries where true temperance has developed over a period of years. However, as Barker says, "Of late, more stress has been laid upon *intoxications* and *infections* as a cause of cirrhosis hepatis." MacCallum,[4] in referring to alcohol as the etiologic factor, states that "although it may well play some part, its influence is undoubtedly greatly exaggerated." In a remarkably thorough and painstaking investigation of this phase of the subject, Friedenwald [5] concluded that "The experimental reproduction in animals of certain of the more characteristic diseases of human beings, attributable to the abuse of alcohol, such as cirrhosis of the liver . . . has not been satisfactorily attained." Much has been done experimentally, but so far little of practical value has been developed. The more important contributions are those of Opie [6] and others, who have combined bacterial infection with various poisons, such as chloroform, which destroy liver cells; Longcope,[7] who has produced lesions resembling those found in cirrhosis by repeated anaphylactic shocks caused by injections of egg white or other protein; and Pearce,[8] who by the injection of hemolytic and hemagglutinative serums caused necrotic lesions and later cirrhotic changes in experimental animals.

Bassler [9] has made an observation from the clinical standpoint, which if confirmed should prove of importance. He states that in 8 per cent

4. MacCallum, W. G.: A Text Book of Pathology, Philadelphia, W. B. Saunders Company, 1924.

5. Friedenwald, J.: The Pathologic Effects of Alcohol on Rabbits, J. A. M. A. **45**:780 (Sept. 9) 1905.

6. Opie, E. L.: On the Relation of Combined Intoxication and Bacterial Infection to Necrosis of the Liver, Acute Yellow Atrophy and Cirrhosis, J. Exper. Med. **12**:367, 1910.

7. Longcope, W. T.: Cirrhosis of the Liver Produced by Chronic Protein Intoxication, J. A. Am. Phys. **28**:497, 1913.

8. Pearce, R. M.: Experimental Cirrhosis of the Liver, J. Exper. Med. **8**:64, 1906.

9. Bassler, A.: Portal Cirrhosis from a Gastro-Enterological Viewpoint, M. J. & Record **119**:121, 1924.

of his laparotomies "an operative note of cirrhosis or cirrhotic liver was made. Since 1915 I have yet to see one instance where at operation whether the individual was alcoholic or not and a portal cirrhosis was disclosed, there was not present and easily demonstrable a saccharobutyric toxemia in the intestinal canal." He further states that in the latter condition an enlarged liver is always found, and infers some connection between the two.

PATHOLOGY

From a pathologic standpoint, portal cirrhosis is a distinct entity. In this condition the typical picture is that of a rough, nodular liver tending

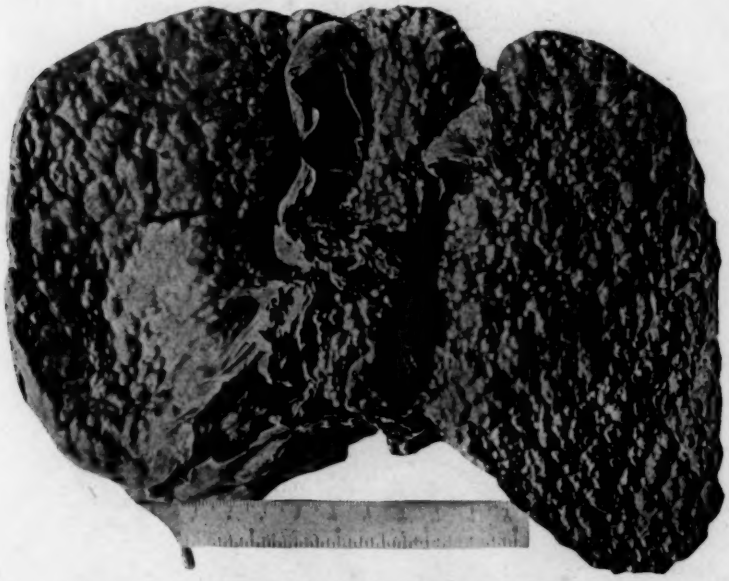

Fig. 1.—Diffuse nodular cirrhosis of the liver. (From MacCallum: A Text Book of Pathology, Philadelphia, W. B. Saunders Company, 1925.)

to be smaller, though actually weighing more than normal. The tissues are not jaundiced. The portal obstruction always present in the late stages is characterized by ascites and by enlargement of the spleen of varying degree. The nodules on the surface of the liver are yellowish brown or chestnut brown (MacCallum). Through the thickened capsule one can distinguish areas of shrunken tissue presenting a gray and translucent appearance. The nodules may vary in size from fine granules to nodules 1 or 1.5 cm. in diameter (fig. 1).

MacCallum says:

> Even the most casual examination shows that these nodules have no longer anything like the normal arrangement of the lobules. They are not, as a rule, isolated nodules, for reconstruction of serial sections shows that they are almost

all connected together into an irregular network, but they have lost their regular relation to the original portal veins, bile-ducts, and hepatic veins. . . .

Microscopical study confirms all this. Everywhere in the section there are found patches of liver-cells arranged in a most disorderly fashion. All bear evidence of having been enlarged by the multiplication of their cells, so that the arrangement with reference to portal and efferent veins is all that will tell us whether we have the enlargement of a whole lobule or of an isolated group of cells. . . . The masses of liver-cells quickly increase in size by multiplication of their cells, new capillaries are formed in every direction, and this labyrinth of cells expands, pressing the stroma away on all sides. For a time

Fig. 2.—Nodular cirrhosis showing atypical arrangement of liver cells in each nodule and extensive scarring. (From MacCallum: A Text Book on Pathology.)

the liver-cells are normal, but then comes another injury, and many of the hyperplastic nodules are partly destroyed. The whole process is repeated, and not only once, but many times. It is clear that this must lead to an extraordinary distortion of the liver's structure (fig. 2).

The pathologic explanation of ascites, the condition for which surgical intervention is really used, is not entirely clear. The progressive cirrhosis described in the foregoing supposedly makes it difficult for the portal blood to pass through the liver, and in consequence the tributaries and branches of the portal vein become greatly distended. This apparent

stagnation of the blood in the portal system impairs the function of the organs drained by it. The spleen becomes enlarged—a condition by no means always found at operation—and digestion is interfered with, although here again appears a discrepancy, for the chronic gastritis of a person addicted to the use of alcohol is presumed to be a primary rather than a secondary factor. As a result of this venous stagnation, fluid filters into the peritoneal cavity; the ascites thus established tends to persist, and by its presence adds to the burden of the already embarrassed portal circulation.

Here as elsewhere in the body, gradual obliteration of a blood channel, whether arterial or venous, results in the formation of collaterals. The development of such new routes following a venous obstruction is never so efficient as in the case of an artery, owing to the marked differences in blood pressure. However, there are few conditions in which adequate collaterals are not established, unless there is a complete thrombosis of all the veins involved. The collaterals formed in cirrhosis of the liver are extensive, and are well described by Charcot, whose diagrammatic representation is shown in figure 3.

One condition associated with cirrhosis and ascites which is seldom referred to is the rather remarkable thickening of the parietal peritoneum. It may be urged that this change occurs in every condition characterized by a chronic peritoneal effusion; yet in no other disease, with the possible exception of a general peritoneal carcinomatosis, is this change so striking. In cirrhosis the parietal peritoneum may attain a thickness of from 2 to 4 mm., and on gross examination may appear markedly injected and hyperemic. This fact has considerable significance in view of the well known absorbing properties of normal peritoneum.

DIAGNOSIS

Unfortunately, the clinical diagnosis of cirrhosis of the liver, even in the presence of ascites, is uncertain. I shall not consider here the diagnosis of the disease before this development becomes manifest, when obviously correct interpretations of signs and symptoms must be even more problematic. However, indigestion, an enlarged, firm liver, splenic enlargement of some degree, pain in the right hypochondrium and a subicteriod tint to the skin and sclera in a person who has led a more or less irregular life suggests possibility of a developing cirrhosis. Actual jaundice is an uncommon symptom and is probably due to some accessory disease. Indications of a developing collateral circulation, hemorrhoids, esophageal varix (hematemesis) and, in the later stages, mild or severe toxic symptoms, add weight to the preliminary evidence. The final stage is the development of ascites, of which Barker says, "of course, after the signs of portal obstruction have developed, the diagnosis

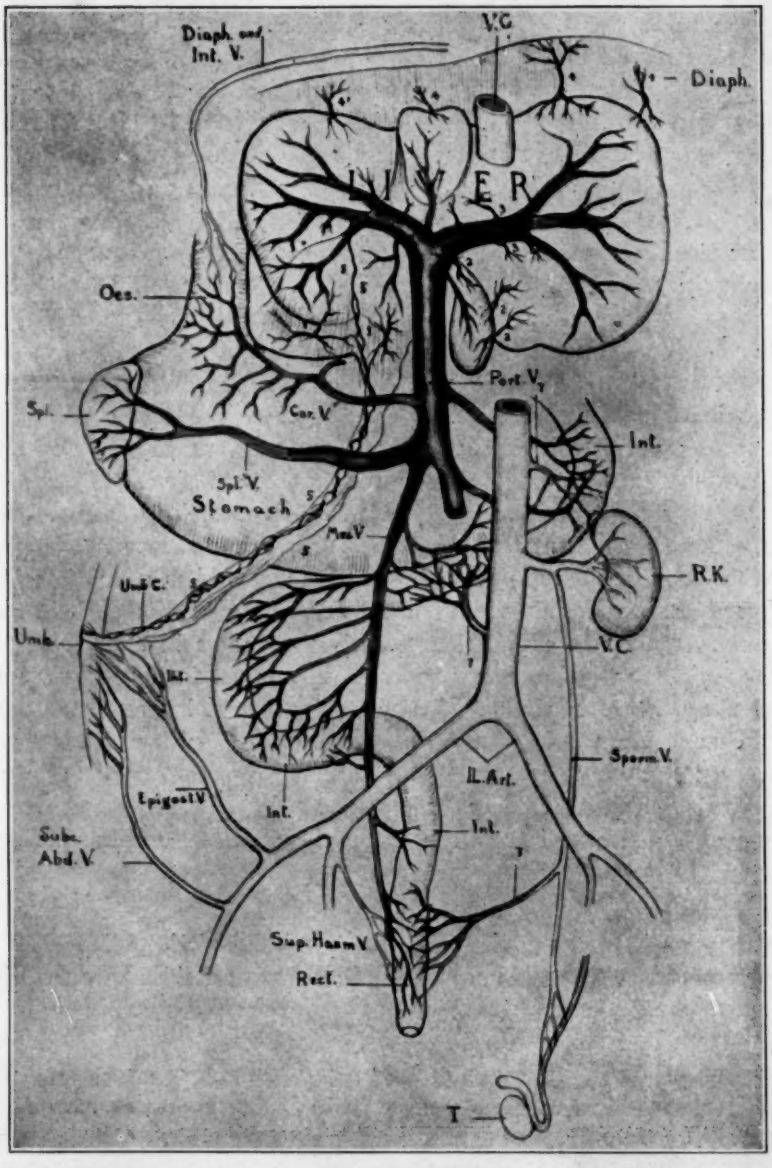

Fig. 3.—Diagrammatic representation of the collateral circulation established in portal cirrhosis of the liver. *1, 2, 3, 4* and *5* indicate the accessory portal veins of Sappey; *7, 7,* veins of Retzius; posterior view. Abbreviations indicate structures as follows: *diaph.,* diaphragm; *oes.,* esophagus; *port. v.,* portal vein; *cor. v.,* coronary vein; *spl. v.,* splenic vein; *int.,* intestine; *mes. v.,* mesenteric vein; *r. k.,* right kidney; *v. c.,* vena cava; *umb. c.,* umbilical cord; *sperm. v.,* spermatic vein; *epigast. v.,* epigastric vein; *sup. haem. v.,* superior hemorrhoidal vein; *subc. abd. v.,* subcutaneous abdominal vein; *il. art.,* iliac artery; *T.,* testicle.

becomes easier." Cabot [10] states that a correct diagnosis was made in 39 per cent of a series of eighty cases—certainly not a brilliant record—while in the same author's statistical review of 5,000 cases of ascites the following diseases appeared most common in the following order of frequency: cardiac, 1,397; renal, 665; cirrhosis, 325; tuberculous peritonitis, 263; ovarian and uterine tumors, 118; abdominal carcinoma, 109; intestinal obstruction, 86.

From these figures it would appear that approximately 7 per cent of all cases of ascites prove at autopsy to be due to portal cirrhosis. Simpson,[11] in discussing the diagnosis of portal cirrhosis, says that ascites is present in 50 per cent of all cases and in 85 per cent of the fatal ones, and that in 13 per cent of all cases in which the patients die of the disease, tuberculous peritonitis is present. When the ascites develops acutely, it is usually a terminal event. In the light of present evidence and the unfortunate lack of pathologic material obtained at operation, it seems justifiable to state that a positive diagnosis of portal cirrhosis can be made in the vast majority of cases only at autopsy. In addition to the conditions listed by Cabot, a differential diagnosis from Banti's disease must be made in the stage of cirrhosis and ascites. But Höpfner says that at this stage Banti's disease often cannot be differentiated from Laënnec's cirrhosis, as in this condition also there may be splenomegaly and changes in the blood following cachexia.

TREATMENT

Höpfner, whose masterly review of the subject stands unique in the literature, classifies the possible methods of treatment as follows:

I. Medical
II. Surgical
  1. Palliative—paracentesis.
  2. Radical
    (*a*) Omentopexy, splenopexy, obliteration of peritoneal cavity, etc.
    (*b*) Direct anastomosis between portal vein and vena cava.
    (*c*) Splenectomy.
    (*d*) Cardiolysis; extirpation of scar or new growth around vein.
    (*e*) Operation with unknown effect; exploratory operations for other purposes.

To this list might be added several methods of later development which involve attempted drainage of the peritoneal cavity either directly into the systemic venous circulation or into some part of the urinary system.

10. Cabot, R. C.: The Causes of Ascites: A Study of Five Thousand Cases, Am. J. M. Sc. **143**:1, 1912.

11. Simpson, A. J.: The Diagnosis of Portal Cirrhosis; Report of a Case, Penn. M. J. **25**:389, 1921-1922.

I am not directly concerned with the medical treatment in portal cirrhosis. That cures have been thus effected is beside the point. Whether the fact that such cases become surgical only when despaired of medically militates against a possibly successful outcome from surgical intervention, it is difficult to say. On the other hand, the surgeon has accomplished little in the thirty or forty odd years of his endeavor to encourage the physician to transfer such cases. However, proper medical control, "when instituted in the formative stage of the disorder" (Osler), may prove effective. The general principles of this treatment involve such measures as rigid control of both food and drink, careful attention to both urinary and alimentary elimination; symptomatic handling of the various digestive disturbances and rational management of the various complications as they arise. Cures reported by the use of antisyphilitic therapy immediately take the case out of the class under discussion. The possibilities of drug therapy are limitless. For instance, Davis [12] reported the case of four patients treated medically with methenamine, elaterium, mild diet and rest, all of whom were cured, one remaining well after six years. He ingenuously remarks that the good results of surgical treatment are due to enforced rest during the surgical regimen. A patient of von Castaigne [13] survived twenty-five years under medical treatment. Mercury and iodides seem to have some virtue, though here the possibility of specific action is again presented. More recently the synthetic compound merbaphen (novasurol) has gained some prominence in the treatment of patients who have ascites. Experience with this drug in one of my cases was not particularly favorable; after the second small dose the patient went into coma, and died within twenty-four hours. Autopsy revealed an advanced portal cirrhosis—a proved case.

Surgical treatment in this intractable disease has an ingeniously wide range. To warrant report of the numerous methods employed, some benefit in an occasional case must have been observed for each new operation. The variety of procedures indicates more clearly than anything else the unsatisfactory results obtained from any particular one. As a matter of surgical interest, the principal methods will be briefly described.

Höpfner's "palliative" surgical procedure, paracentesis abdominis, is undoubtedly the most widely used of all methods of treatment. It cannot, however, in any sense be regarded as a strictly surgical measure, for it is practiced with much greater frequency by the physician than by

12. Davis, N. S.: Non-Surgical Treatment of Cirrhosis of the Liver, J. A. M. A. **61**:273 (July 26) 1913.

13. Von Castaigne, J.: Sur un cas de cirrhose de Laënnec ayant évolue pendant 25 ans, Bull. Soc. anat. de Paris **72**:94, 1897.

the surgeon. Probably as many cures have been obtained by its employment as by any other single method. It is necessary to perform paracentesis on practically all patients postoperatively. According to Weber,[14] cures following repeated paracentesis are "probably due to the formation of omental adhesions and gradual improvement of the collateral circulation." A mild peritonitis resulting from the repeated paracentesis doubtless plays an important rôle in these cures, as in Riesman's [15] case. The patient, on whom paracentesis was performed thirty-six times for a total of 150 gallons, developed a fibrinous peritonitis after the last time, and was cured. Paracentesis was carried out in Drummond and Morison's [16] famous first case forty-eight times before operation and sixty-one times subsequently. Examples could be multiplied indefinitely. There is apparently no limit to the number of times paracentesis can be carried out. Cases have been reported in which the patients survived 60, 111, 162, 298 and 303 tappings. Such cases are certainly not the rule, for, as Hale White [17] says, "The patient with ascites seldom survives many punctures."

The so-called radical surgical methods offer numberless variations. The history of the first reported cases is now familiar to every one. Though published in 1896, Drummond and Morison's case followed by several years Talma's [18] first two cases in which the patients were operated on by Menlin in 1889 and by Schelky in 1891, respectively, though Talma did not report them until 1898. The general procedure of omentopexy is called the Talma-Morison operation. Variations of this procedure are as frequent as the operations performed. Probably two such operations have never been performed alike by the same surgeon. Schiassi [19] has suggested an extension of the procedure. Incidentally, this author states that with his operation "the liver is examined carefully as are all other abdominal viscera and the existence of indications for operation are verified." This examination he regarded as "essential," and occasionally made further verification by histologic examination of tissue removed at operation. This statement, though made twenty-six years ago, stands almost unique in the literature, and is of course of fundamental importance. All the abdominal viscera have been trau-

14. Weber, F. P.: Hepatic Cirrhosis and the Question of the Operative Treatment of Chronic Ascites, Internat. Clin. **1**:88, 1924.

15. Riesman, D.: Spontaneous and Operative Cure of Cirrhosis of the Liver: Report of Illustrative Cases, J. A. M. A. **76**:288 (Jan. 29) 1921.

16. Drummond, D., and Morison, R.: A Case of Ascites Due to Cirrhosis of the Liver Cured by Operation, Brit. M. J. **2**:728, 1896.

17. White, W. H.: Cirrhosis of the Liver, Guy's Hosp. Gaz. **12**:205, 1898.

18. Talma, S.: Chirurgische Oeffenung neuer Seitenbahnen für das Blut des Vena Porta, Berl. klin. Wchnschr. **35**:833, 1898.

19. Schiassi, B.: La déviation chirurgicale du sang de la veine porte, Semaine méd., 1901, p. 145.

matized more or less unmercifully and the diaphragm and the liver scrubbed with a coarse brush, the latter even painted with iodine, and occasional benefit has been noted. In all of these operative methods increase in the portal collateral bed is sought. That new channels are established is undoubtedly true, for, as W. J. Mayo [20] states, "The extent of collateral circulation established in this way is extraordinary. In several cases I made an incision mostly for other purposes, some time after omentopexy and encountered so much venous bleeding that I had to desist." In a case of mine in which the patient died three weeks after operation the portal circulation was injected, and definite collateral channels were found to be already established. Indeed, such vascularization is a familiar observation in ordinary omental adhesions when no portal obstruction exists—a fact of considerable significance in weighing the value of results obtained by omentopexy in cirrhosis with ascites.

Obliteration of the peritoneal cavity is usually accomplished more by accident than by design, and probably as frequently by repeated tappings as by actual operation. If the procedure of draining a peritoneal cavity filled with ascitic fluid can have any justification, it is only on the basis of producing an intentional and inevitable peritonitis. Several cases are recorded in which ascites disappeared after a period of pyrexia and abdominal pain. Removal of a considerable portion of parietal peritoneum suggests itself as a possible means of accomplishing the same purpose. The operation of splenopexy, a rather formidable procedure, seems to have no possible rational basis.

Direct anastomosis between the portal vein and the inferior vena cava is by far the most alluring possibility of surgical treatment, but, though carried out successfully on animals in every experimental laboratory, few surgeons have had the temerity to apply it to human beings. One of the most interesting studies of the so-called Eck fistula from an experimental standpoint was that made by Hahn, Massen, Nencki and Pawlow [21] in 1892. Of sixty animals, two-thirds died, while the remaining twenty were studied with the greatest care. These authors call attention to the similarity between the clinical picture which these animals presented and the terminal uremia exhibited in man in the presence of an advanced portal cirrhosis. The moment food was given, many animals developed symptoms of coma, and some died. It must be remembered that in the human being in whom cirrhosis has been gradually developing over a long period of time the few remaining liver cells

20. Mayo, W. J.: The Surgical Treatment of Hepatic Cirrhosis, Ann. Surg. **80**:419, 1924.

21. Hahn, M.; Massen, V.; Nencki, M., and Pawlow, J.: La fistule d'Eck de la veine cave inférieure et de la veine porte et ses conséquences pour l'organisme, Arch. d. sc. biol. de St. Petersburg **1**:401, 1892.

undoubtedly preserve the balance between actual life and death. Furthermore, it is likely that as the blood of the portal system is diverted by collateral circulation, whether spontaneously or as the result of surgical measures, the toxic symptoms which develop late in the disease may be due directly to this factor. Certainly ascites alone has never been the actual cause of death. As will be seen in the cases listed below, death followed operation in the great majority of instances after a comparatively brief time. Hahn and his co-workers believed that in the animals that survived an Eck fistula for a period of more than two weeks a collateral circulation probably developed through the liver, and these investigators felt that they had confirmed this observation by injections. Such a result in a person whose liver cells have already been largely replaced by scar tissue would seem highly improbable, although several authors surmise that after successful operative measures of any character the liver cells tend to regenerate. There is apparently no sound basis for such a contention. Furthermore, it is a well known fact that following the production of an Eck fistula many animals die of septicemia.

It seems, therefore, that though theoretically ideal for the relief of ascites, the diversion of all the portal blood directly into the systemic circulation in the presence of a cirrhotic liver is a procedure without proper, if indeed any, justification. Consideration of the technical difficulties of performing an Eck fistula on a human being is purely incidental in relation to the inevitably fatal outcome following its successful execution.

Splenectomy in portal cirrhosis is a method of treatment which has for its rationale only the obliteration of a considerable portion of the actual portal venous bed. Confusion in diagnosis is more evident in this group of cases than in any other. W. J. Mayo,[22] for instance, speaks of ninety-seven patients on whom splenectomy was performed for splenic anemia, of whom forty-two "had more or less portal cirrhosis," while in nine cases of primary portal cirrhosis splenectomy and the Talma operation were performed; of the latter patients, two died in the hospital. Certainly few patients suffering from cirrhosis with ascites who present themselves for operation could withstand the rather extensive surgical measures necessary in splenectomy and omentopexy. The immediate postoperative mortality of the Talma-Morison operation is slight. In only one of the cases of my series was splenectomy performed, and in that one the diagnosis was not absolutely clear.

Many cures have been reported following operations performed for some other purpose. Dr. Dean Lewis has described to me a case in

22. Mayo, W. J.: The Surgical Treatment of the Cirrhoses of the Liver and Their Complications, Ann. Surg. **68**:183, 1918.

which the patient was apparently cured by an operation for umbilical hernia, and Weber reports a similar instance. Frequent mention is made of cures in cases in which only an abdominal incision was made. There can be little justification for such conclusions unless the diagnosis has been confirmed beyond all peradventure.

Direct drainage of ascitic fluid into the blood stream by implantation of the saphenous vein in the peritoneum was described first by Ruotte [23] in 1907. This method is strictly designed to relieve a symptom, and in consequence is worthy of considerable attention; it is of additional interest in view of the fact that the large quantities of ascitic fluid with its contained protein are conserved for the patient. Repeated paracentesis necessarily results in a total loss of the material, and contributes to the patient's progressive loss of strength. Restoration of ascitic fluid by intravenous infusion has been practiced. Ruotte, Soyesima [24] and, most recently, Miller [25] have reported series of cases in which the patients have been treated by venoperitoneostomy. For relief of ascites the method seems to offer considerable promise, the only difficulty being the length of time during which the vein will remain patent. Urinary secretion is greatly increased, the fluid is drained satisfactorily, and, curiously enough, the heart is apparently unaffected by what must certainly be temporarily a greatly increased volume of blood. The operation itself is attended by a minimum amount of shock.

The more bizarre methods of surgical therapy, such as drainage of ascitic fluid directly into the bladder through a valvular opening in the fundus, suggested by Rosenstein; [26] the employment of silver tubes to effect permanent drainage into the subcutaneous tissues, and the utilization of the kidney pelvis and ureter as the drainage tract obviously involve a surgical risk out of all proportion to any likely benefit.

INDICATION FOR SURGICAL TREATMENT

The lack of accord between the physician and the surgeon as to the proper time for the institution of surgical intervention is undoubtedly the most serious obstacle to possible success. The failure of surgical treatment to show any uniform degree of benefit has developed a more or less natural hesitancy on the part of the internists to subject their patients to operation. There can be little doubt, however, that the

23. Ruotte: Abouchement de la veine saphène externe au peritoine pour résorber les épanchement sciatiques, Lyon méd. **109**:574, 1907.

24. Soyesima, von Y.: Beitrag zur operativen Behandlung das Ascites bei Lebercirrhose, Deutsche Ztschr. f. Chir. **98**:390, 1909.

25. Miller, R. T.: The Surgical Treatment of Ascites. Direct Drainage of the Fluid into the Blood Stream by Implantation of the Saphenous Vein in the Peritoneum: Report of Five Cases, Penn. M. J. **19**:413 (March) 1916.

26. Rosenstein, P.: Ventilbildung an der Harnblase zur Ableitung der Ascites flüssigkeit, Zentralbl. f. Chir. **41**:373, 1914.

patients with portal cirrhosis and ascites are brought to the surgeon at a stage in the disease when little can be expected from any method of treatment. Furthermore, the uncertainty of both medical and surgical diagnosis adds greatly to this general confusion. If operation should be resorted to early, what is the proper time for such intervention? Practically all surgeons agree that surgical treatment should be instituted early and not as a last resort. Theoretically, the establishment of collaterals before ascites develops would be the ideal method of treatment. If there is any justification for surgical measures, the operation should be performed immediately after the ascites appears and not after repeated tappings have debilitated the patient to an extreme degree and failed to afford any permanent relief. Might not prompt exploratory operation, in the absence of a clear indication of cardiac or renal disease, offer these patients with ascites a greater chance of benefit? Time lost in arriving at a 35 per cent correct diagnosis, though of academic importance, can add little to the patient's span of life.

Weber classifies the cases from a surgical standpoint in two groups:

Group A: Patients who for some reason—for instance, the presence of old perihepatitis and perisplenitis and extensive spontaneous omental adhesions—have a well established collateral venous circulation and do not readily develop ascites, but are of course liable to hematemesis from dilated esophageal or gastric veins. The liver is generally decidedly enlarged in this group of cases. Group B: Patients with a poor collateral venous circulation who develop ascites early. Weber maintains that the object of omentopexy and peritoneal drainage should be to convert group B patients into group A patients. Obviously, the sooner the collaterals are established the better the effect should be.

The results of surgical treatment as reported in the literature are extremely difficult to analyze. From general compilations of reports of cases and series, it seems that cures and marked improvement may be expected from all methods in from 35 to 50 per cent of the cases. No figures or data are available as to the optimum time in the course of the disease for surgical treatment or the actual type of operation offering the greatest chance of relief. Some form of omentopexy is the operation of usual choice, so that to it must be given the greater part of whatever credit belongs to surgical treatment. Few series have been reported, however small, in which some apparent benefit has not resulted from operation. Combined treatment, medical and surgical, may produce benefit when the surgeon or internist alone can accomplish little. Certain it is that the disease is one which at the present time can have only one outcome under strictly medical control. If in an established case operation can offer any hope of benefit—and apparently it can—the surgeon should see the patient early and determine the moment best suited for operation.

PRESENT SERIES

In the study of the present series great difficulty has been encountered in selecting from the rather considerable group of cases listed saportal cirrhosis with ascites those which belonged definitely to this group. At first about fifty cases were selected. After critical examination of the history and analysis of the operative observations, twenty-six cases were chosen as representing more or less accurately the disease, portal cirrhosis (table of cases). In the earlier cases a careful operative note as to the condition of the liver, the degree of dilatation of the portal tributaries and the apparent thickening of the peritoneum, together with negative observations as to tuberculosis, carcinoma and other diseases, had to serve as the basis of selection. Autopsy records offered conclusive proof in a small number of cases, and in the more recent ones a section of the liver removed at operation furnished the necessary evidence. Two of the cases that I list still seem doubtful, but they have been included on a more or less reasonable basis. It will be seen, therefore, that in a group of fifty cases diagnosed clinically as cirrhosis of the liver, confirmed to some degree at operation and subjected to a properly critical analysis, only 50 per cent can be placed with accuracy in this group. These patients have been operated on over a period of about thirty years by a succession of surgeons representing, of course, varying degrees of skill and judgment. There is only one considerable series of patients operated on by a single surgeon; it includes twelve of the total number of cases. In this particular group a variety of operations was performed, but each involved laparotomy with some additional measures. Few of the earlier cases were followed, and the last clinical note has of necessity been taken as the probable duration of life; the later cases indicate that these figures probably are accurate.

Though statistics are of no particular significance, this series seems of sufficient size to warrant tabulation of certain facts evolved from a study of the cases: Comparison with other reported series has been purposely avoided, as I believe no group of similar size has previously been compiled on the basis of the standards outlined above.

Twenty-six patients are represented; of these twenty-two were males and four females, twenty white and six colored. The average age was 42 years; the youngest, 4½ years, and the oldest, 66 years. The decades were represented as follows: first, 1 case; second, 2 cases; third, 1 case; fourth, 3 cases; fifth, 9 cases; sixth, 8 cases, and seventh, 2 cases. More than half of the cases, therefore, occurred in the fifth and sixth decades.

Discrepancies between the subsequent data and the total number of cases are accounted for by lack of data in the clinical records. The

average duration of symptoms of all kinds before operation is eight months, the shortest twelve days and the longest two years. The onset was characterized by acute abdominal pain in eight cases, abdominal swelling in thirteen and hemorrhage in three. Fifteen of these patients gave a definite history of potatorium; five had syphilis. In the patients on whom paracentesis was performed before operation this procedure had been carried out for an average of four times and an average amount of seven liters of fluid had been obtained. Dilated superficial abdominal veins were noted in five cases. The following operations were performed, more than a single procedure was carried out at one time in some instances: simple laparotomy, 3; peritoneum and liver scrubbed, 9; omentopexy (all varieties), 12; cholecystostomy, 2; splenectomy, 1; liver painted with iodine, 1.

Reaccumulation of fluid is recorded in seventeen cases, in all of which paracentesis was performed from one to eight times postoperatively. Three patients were treated by drainage. One patient (case 23) was alive and in good health three and one-half years after operation. This case will be referred to later, as it is the only one in the group of twenty-six in which the clinical diagnosis alone was accepted as final. When last heard from, one patient, the first, was alive eight months after operation; two patients were alive four months, two, two months and four, one month after operation. These patients subsequently failed to answer letters of inquiry. Sixteen of the twenty-six patients are known to be dead, having survived operation for an average of twenty-two days, six of this number died within one week; four survived a month; one two months and one approximately three months. All types of anesthesia were used.

An analysis of the data in the preceding paragraph and some further specific observations fail to support any of the favorable conclusions arrived at in other reported series. In this group of cases particular emphasis has been laid on the operative confirmation of clinical diagnosis. In three instances such evidence was not available from the records. In the first case, in which operation was performed on Nov. 6, 1896, the history and the notes of the physical examination were classic descriptions of portal cirrhosis with ascites. The operation of "median laparotomy" was performed simply to liberate the ascitic fluid, no mention being made of the condition of the liver. A note made in June, 1897, states that there was no fluid in the abdomen and no edema of the legs, and that the patient had resumed a thirty year custom of drinking heavily.

The youngest patient in the group (case 19), on whom a splenectomy was performed, died four days after operation. This case does not belong strictly to the portal cirrhosis group, as the pathologic picture was

Compilation of Twenty-Six Cases of Portal Cirrhosis with Ascites

No.	Sex	Race	Age	Duration	Tapped	Times Tapped	Average Amount	*a.* Potatorium *b.* Syphilis	Type of Onset	Comments on History	Operation	Postoperative Course	Course After Operation	Comments
1	M	W	50	12 days	—	—	—	*a.* ++++ *b.* —	Acute abdominal pain	On spree for three days	Laparotomy 11/6/96; release of fluid	Two weeks later slight reaccumulation	Well 8 mo.	Started drinking again
2	M	C	41	1 mo.	—	—	—	*a.* — * *b.* —	Acute	.....	I. 2/8/97: peritoneum scrubbed; II. 3/6/97: laparotomy, 9 liters	3/3/97: marked reaccumulation; 4/2/97: reaccumulated; 4/19: 6 liters	Alive May 1	Transferred to medical service; liver enlarged, peritoneum thick
3	M	C	37	2 yr.	+	3	3 liters	*a.* ++++ *b.* +	Attacks of dyspnea	Medical treatment successful; large veins	2/10/97: liver and peritoneum scrubbed	Tapped twice no relief	4/12/97; discharged	Became hysterical
4	M	W	44	—	—	—	—	—	—	—	9/16/97: liver and peritoneum scrubbed, 2 liters	Pleural peritoneum; fluid three times 7/6; 8 liters	10/22/25: transferred	Large hobnail liver; peritoneum thick
5	M	C	40	5 mo.	+	5	9 liters	*a.* + *b.* —	Swelling in legs and abdomen	.....	8/20/00: 6 liters liver, glans, peritoneum scrubbed	Great shock	8/23/00: dead	Hobnail liver; thick peritoneum
6	M	W	51	1 mo.	+	2	13 liters	*a.* ++++	Gradual swelling	.....	4/25/02: liver and peritoneum scrubbed; omentum adhered to abdominal wall	5/19/02; tapped, 9 liters	5/30/02; died in coma	Hobnail liver; thick peritoneum; large veins
7	M	W	42	9 wk.	+	2	3-4 liters	*a.* +	Nausea and vomiting	.....	5/8/02: liver and peritoneum scrubbed, drained	.....	5/11/02: dead	Hobnail liver; thick peritoneum; stupor
8	F	W	55	4 mo.	+	2	5-7 liters	*a.* +	Hemorrhage, pain, vomiting, swelling	Large veins over abdomen	10/5/02: liver scrubbed; rubber drainage tube inserted	.....	10/7/02: dead	Cirrhotic liver; veins greatly dilated
9	M	W	13	2 mo.	+	1	6 liters	—	Hemorrhage and swelling	.....	3/20/03: liver, parietal and visceral peritoneum scrubbed with gauze; omentum to abdominal wall	4/6/03: tapped; 4/16: 8 liters 4/23: 7 liters	4/26/03: dead	Hobnail liver; thick peritoneum
10	M	W	55	1 mo.	+	1	5 liters	*a.* ++	Pain over liver	Jaundice for 1 year, slight	3/15/07: peritoneum scrubbed	3/20: 4 liters	3/23: dead	Liver cirrhotic; gallbladder thickened; fluid rather milky
11	M	W	62	6 mo.	—	—	—	*a.* ++	Abdominal pain, no swelling	Slight jaundice	10/28/08: cholecystostomy	6/ 5: 8 liters	12/9/08: improved	Cirrhotic liver; contracted gallbladder; liver small and cirrhotic
12	M	C	22	2 yr.	—	—	—	*a.* ++++	Swelling only	More rapid swelling in months before operation	5/23/10; laparotomy; 5/23/10 18 liters	6/11: 8 liters 6/18: 5 liters 6/23: 6 liters 7/ 1: 5 liters 7/ 7: 4 liters 7/13: 3 liters	Improved 9/31/10; fluid forming much more slowly	Abdomen simply explored

13	M	W	40	1½ yr.	+	13	?	*a.* ++++ *b.* ++++	Swelling of feet and ankles; hemorrhage 6 mo. before Dr. Hughson was consulted	Prominent veins	2/20/14: omentopexy (Schiassi) 10 liters	2/25: 2 liters (pleura) 2/28: 7 liters 3/ 8: 7 liters 3/12: 7 liters 3/24: 7 liters	5/8: ascites still present; pt. ill; 5/12: died in coma	Liver cirrhotic; omental veins dilated
14	M	W	55	10 mo.	+	3	20 liters 12 liters 10 liters	—	Jaundice	.....	9/6/16: omentopexy, 10 liters	9/26: 7 liters	Increase slow; 10/2/16: improved	Liver large and hobnail
15	M	W	41	2 mo.	+	3	5 liters 5 liters 5 liters	—	Abdominal pain, vomiting	—	9/14/21: Talma operation on liver and peritoneum scrubbed	.....	No recurrence of ascites; 10/13: discharged improved	Liver not typical hobnail, described as dark red with irregular surface; adhesions present
16	M	W	43	4½ mo.	+	12	5-8 liters	*a.* ++++ *b.* ++++	Abdominal pain, vomiting	Acute nephritis, jaundice; ascites returned	3/6/24: omentopexy; large amount of fluid 10 liters	3/ 8: 6 liters 3/11: 8 liters six other times average 7 liters	3/25/24: no relief; death	Marked cirrhosis; hobnail liver; autopsy: large spleen
17	M	W	58	4 mo.	+	3	4 liters 4 liters	—	Jaundice, chills and liver	Ascites came on later	2/9/25: omentopexy; liver and and peritoneum scrubbed; 4 liters	2/18/25: 2 liters	2/23/25: improved (?) 3/9/25: dead	Cirrhotic liver; everything else thought normal
18	M	W	48	1 yr.	+	5	?	Three glasses of beer per day for 7 yr.	Swelling of ankle and abdomen	.....	6/25/25: Schiassi omentopexy	7/10: 5 liters 7/19: 8 liters 7/25: 7 liters	8/1/25: dead	Hobnail liver, thick peritoneum; death followed; merbaphen (novasurol); autopsy
19	M	W	4½	—	—	—	—	—	Weekly swelling of abdomen, fluid	Collateral cirrhosis marked	7/17/24: 1 liter splenectomy	—	7/21/24: dead	Spleen slightly enlarged
20	M	W	31	4 mo.	Op. 2 mo. ago	4	5 liters	*a.* ++++ *b.* ++++	Heavy feeling in stomach	No response to antisyphilitic treatment	10/25/23: omentopexy, 3 liters	11/1: 5 liters 11/7: 6 liters	11/8/23: discharged to Bay View	Cirrhotic liver; dilated veins; peritoneum thick
21	M	W	51	18 mo.	+	4	6-7 liters	*a.* ++++	Vomiting, swollen stomach	Liver function test points to cirrhosis	3/3/24: omentopexy; liver painted with iodine	3/6: 7 liters	4/23/24; dead	Hobnail liver; cirrhosis
22	M	W	48	4 mo.	+	8	?	?	Swelling	Large veins	8/8/23: omentopexy	—	8/8/23: dead; hemorrhage	Cirrhotic liver; huge omental veins; autopsy
23	M	W	66	—	—	—	—	—	Clinical diagnosis of ascites and cirrhosis	—	12/22/00: cholecystostomy	—	10/21/01: well; no difficulty; gained 20 lbs. (9 Kg.); 5/2/03: good health	No exploration of liver at operation
24	F	C	16	2 yr.	+	3	Large amount	—	4/22/06; medical service; with C-R. neg.; large liver; ascites; lump in abdomen; pain, swelling, dyspnea	Fluid and large liver	8/1/07: suture of liver and omentum to parietal peritoneum	—	8/30/07: excellent condition	Before operation fluid had disappeared, liver soft and mottled; adhesion between liver and parietal wall
25	F	W	31	1½ yr.	—	—	—	Wassermann reaction negative	Large liver and spleen	No fluid	11/17/16: exploratory laparotomy, fluid	—	11/20/16: dead, coma	Liver hard, rough and contracted; cirrhotic
26	M	W	53	2 yr.	—	—	—	Slight drinking	Fulness in flanks; jaundice	Liver and spleen large and firm	4/25/17: cholecystectomy; large amount of fluid	—	5/23/17: much improved, no fluid	Liver enlarged and cirrhotic, also spleen; stones in gallbladder

much more that of Banti's disease. In case 18 a positive clinical diagnosis of portal cirrhosis with ascites was made at operation on Dec. 22, 1900. Exploration was not made of the liver, or at least no observations were noted in the history, but stones were found in the gallbladder, and a cholecystostomy was performed. Three and one-half years after operation this patient was alive and well, having gained 20 pounds (9 Kg.). This represents the longest known period of survival in this group of cases, and occurred in a patient presenting ascites and a clinical diagnosis of portal cirrhosis without operative confirmation. It seems reasonable to regard this as an unproved case and consequently of little value in relation to end-results.

There are, therefore, two unproved cases representing the longest periods of survival following operation, eight months and three and one-half years, respectively, in which operations were performed without reference to any idea of establishing collateral circulation. And these are the only cases in the series of twenty-six which can be regarded as offering any justification for surgical treatment in portal cirrhosis with ascites. The first patient was operated on two months after the publication of the article by Drummond and Morison, and the operator was no doubt unfamiliar with the procedure of omentopexy.

Of the remaining patients, a simple laparotomy was performed on one (case 12), and his abdomen was tapped six times after operation; five months later he was considered improved, since fluid was forming much more slowly. This patient was then lost to observation, so far as further records are concerned. The patients in cases 2, 3, 4, 14, 15 and 26 were followed for a brief period and also lost. The patient in case 26 showed jaundice, the only one in the group, and he was possibly ineligible on that account. It has been an almost invariable experience that patients with atrophic portal cirrhosis do not have jaundice. This patient had a cholecystectomy performed, and at the end of one month was considered improved. The remaining seventeen patients, or 65 per cent of the total number, not only did not show improvement, but they died on an average of three weeks after operation. In each of these cases there was operative confirmation of a clinical diagnosis; in several the additional support of autopsy observations was available. In other words, the only patients in whom there was no reasonable doubt as to the diagnosis and who could be followed for a sufficient length of time died within an average of three weeks after operation. In every instance the operative measures were designed to increase the collateral circulation of the portal system.

In these twenty-six cases a relation between the general postoperative course, the total period of survival or the temporary degree of improvement and the duration of the disease before operation is not apparent.

Frequent preoperative tappings were not associated with improvement any more than with fatality, nor did the particular decade seem to influence the general course.

COMMENT

The difficulty of reconciling the facts outlined in the foregoing study with the numerous reports in the literature is apparent. Observers of unquestioned accuracy and authority list in their series of published cases instances of definite cure. Weber, for instance, reports a patient alive eight and one-half years after operation. In an article on the surgical treatment of hepatic cirrhosis, W. J. Mayo reports forty-seven operative cases with seven deaths in the hospital, twenty-one patients alive when last heard from, and four patients well at nine, eight, seven and five years, respectively. The differentiation of cases in this series is not clear, as the splenic anemias are all described as being associated with "more or less portal cirrhosis." The same author states that the "Talma-Morison operation per se carries only a slight risk." Riesman reports three interesting cases resulting in cure, one after thirty-six tappings and the development of a fibrinous peritonitis, and the other two following omentopexy. He further says: "I have seen the Talma operation fail, owing I believe to my having postponed it too long," and he also believes that "cure of its outstanding symptom, namely the ascites, brings about arrest or cure of the cirrhotic process . . . the damage done to the liver seems to be compensated." Judd and Lyons [27] say that in the presence of jaundice and a large amount of ascites the Talma-Morison operation has not been satisfactory, while in cases in which there is no jaundice and in which the quantity of ascites is not too great or the liver too badly diseased, this plan of transferring the circulation has seemed to accomplish a great deal. This is a reasonable statement of fact, it seems, for in the first group there would be no indication for the operation and in the second there would surely be doubt of existent disease. King [28] reports an interesting case of a woman who was operated on when bedridden and delirious; paracentesis was performed fifteen times after operation, and four years later she was apparently cured. In 1918, W. J. Mayo reported five of twenty-eight patients treated by the Talma operation as cured. Hale White's collected series is most striking. Of the hypertrophic variety, twenty-four cases are listed with ten patients cured, six improved, three unim-

27. Judd, E. S., and Lyons, J. H.: The Mortality Following Operations on the Liver, Pancreas and Biliary Passages; a Statistical Study, Ann. Surg. **78**:194, 1923.

28. King, E. L.: Presentation of a Case of Cirrhosis of the Liver; Talma Operation; Entire Relief from Symptoms, New Orleans M. & S. J., 20, **72**:529, 1919.

proved and five dead. Of the atrophic group of sixty-two cases, thirty-eight were cured, seven improved, seven unimproved and twenty-seven dead.

Eliot and Colp [29] summarize their observations by saying that the most favorable cases occur between the second and fourth decades in fairly well nourished persons without severe nephritis, cardiac lesions or compensatory circulation, with a hypertrophic liver, on whom paracentesis has been performed a few times, and in whom disease comes on slowly for one year or more. "That the operation under local anesthesia is a benefit in carefully selected cases," they say, "there can be no doubt." These qualifications seem difficult of fulfilment. In the series herewith reported only six of the total number of twenty-six cases developed in persons between the second and fourth decades; the average preoperative period was eight months as against an optimum of a year or more; superficial collateral circulation appeared in a comparatively small number of patients, and on the majority paracentesis was performed one or more times prior to operation. As has already been noted, no significant difference could be recognized in the general postoperative course of any of these patients. Such data can be multiplied indefinitely from reports of series and isolated cases, but the purpose of the present discussion is not to compile the reported cases.

SUMMARY

The problem under discussion must be regarded from several angles. In the first place, the disease is comparatively rare, and offers many difficulties from the standpoint of differential diagnosis. Cabot states that a correct diagnosis was made in 39 per cent of eighty cases. From our own observation this proportion seems too high. The only positive method of diagnosis is by section at operation or by autopsy. Hemorrhage and ascites are inconclusive. Hepatic enlargement is referred to frequently as a favorable circumstance, and yet a large liver is present in many conditions which cannot possibly be regarded as true portal cirrhosis. Of my last three patients suffering from "portal cirrhosis with ascites," at operation one was found to have syphilis, another, tuberculosis and the third Banti's disease with secondary enlargement of the liver.

The surgical treatment of portal cirrhosis with ascites, except for the methods designed to institute direct drainage, is a random sort of procedure. On the basis of an omentopexy of some type to stimulate an extensive collateral circulation, every imaginable method has been employed, as indicated in the present series; the liver and the intestines

29. Eliot, E., and Colp, R.: The Operation of Omentopexy in Cirrhosis of the Liver, Surg. Gynec. Obst. **28**:309, 1919.

have been scrubbed and the liver has even been painted with iodine; in every instance death has ensued with varying degrees of promptness. Drainage and nondrainage have their advocates, the objection here as elsewhere being directed against the likelihood of infection of a previously sterile effusion. And yet one frequently encounters in the literature the significant observation that an apparently mild peritonitis with its associated pain and fever was followed by an apparent cessation of the production of ascites. This peritonitis has followed both surgical treatment and what may be called medical drainage, or paracentesis.

A brief digression may be made here to emphasize again the almost uniform observation of a thickened peritoneum. Simpson draws attention to this fact, and states that most cases show a chronic peritonitis. It is probably safe to go further and say that all cases of any particular duration exhibit a chronic peritonitis. The peritoneum normally absorbs fluids rapidly. The thickened peritoneum of a portal cirrhosis could not possibly absorb, and undoubtedly plays a fairly important part in elaborating the fluid. Might it not be reasonable, therefore, to explain possible benefit obtained from surgical intervention on the basis of obliteration of the peritoneal cavity from whatever cause rather than from the establishment of a doubtfully adequate collateral circulation? As a possible form of treatment, removal of large areas of parietal peritoneum suggests itself for the surgical obliteration of the peritoneal cavity without having recourse to infection.

Late improvement following surgical treatment has been explained on the basis of a regeneration of liver cells following the relief of the portal circulation. There is, of course, no evidence to support such an assumption, and again the difficulty of correct diagnosis must serve to temper enthusiasm in analyzing favorable results.

CONCLUSION

In the present series of twenty-six cases, regarded as correctly diagnosed from either operative or autopsy observations or both, it is impossible to conclude that surgical treatment instituted for the purpose of establishing additional collaterals is of the slightest benefit in portal cirrhosis with ascites.

Furthermore, from a study of this series no evidence can be adduced which would indicate that any particular age, sex, race, period of disease or time of appearance of ascites is more favorable for the employment of surgical measures than any other. It seems true, however, that in the great majority of cases operation was performed as a last resort; this statement is made without reference to the possible advantage of surgical intervention.

The difficulty of accurate diagnosis must be borne in mind in reporting favorable surgical results. None but proved cases should be listed.

On the basis of correct diagnosis, which is estimated at 40 per cent, the figure generally accepted as representing the expected benefit from operation, 35 per cent, would fall to approximately 10 per cent, and more careful analysis would undoubtedly reduce the estimate even further. An additional source of error lies in the loose application of the term cirrhosis; omentopexy and its subsequent variations and elaborations were designed for the treatment of portal cirrhosis with ascites.

Though the fact possibly has no significance so far as the etiology of the disease is concerned, it is noteworthy that 60 per cent of the patients in the present series gave a definite history of potatorium.

INVAGINATION ILEUS IN POLYPOSIS OF SMALL INTESTINE*

REXWALD BROWN, M.D.
SANTA BARBARA, CALIF.

REPORT OF CASE

S. B., a girl, aged 21 months, was sent to the Santa Barbara Cottage Hospital on June 7, 1926, by Dr. E. J. Lamb, who had made a diagnosis of intussusception. I saw the child, concurred in the diagnosis and opened the abdomen at once, twelve hours after the onset of symptoms. An intussusception was found in the small intestine about 1 foot (30.4 cm) above the ileocecal juncture. The invagination was reduced by manipulation. When normal continuity of the bowel was restored, complete obstruction by a solid mass was found in that portion of the intestine which had been the intussusceptum. A portion of intestine, 3 inches (7.6 cm.) long, which contained the mass, was resected, and a lateral anastomosis was performed. The child made an excellent recovery and is now in good health.

The pathologist of the hospital, Dr. F. R. Nuzum, reported that the tumor was a benign intestinal polyp with a broad base.

REVIEW OF THE LITERATURE

Beginning with R. C. Coffey's comprehensive paper on intussusception, which appeared in 1907, I have made a considerable survey of the literature on intussusception. Since Coffey's paper, in which he reported a mortality of from 70 to 90 per cent, the range of mortality in the services of various physicians who have handled this condition or reviewed a series of cases from several clinics has been from 25 to 65 per cent. There is one record of stellar prominence, however, in the management of intussusception, that of Hipsley of Australia, who operated on fifty-one patients, without a single death. This outstanding achievement is a challenge to American physicians to better understanding of intussusception, an anatomic tragedy which, though not rare, is by no means of common occurrence in the routine practice of internists, pediatricians and surgeons. Hipsley's success was due to accuracy of diagnosis, dependent on symptoms as classic as those of acute appendicitis, and to immediate operation following diagnosis. All of the fifty-one patients were treated surgically within thirty-six hours after the onset of the condition. Deaths occurred in Hipsley's service when operation was not performed until thirty-six hours had passed since the onset of intussusception.

The high mortality in America is due, first, to failure of physicians to appreciate the significance of intermittent screaming and crying,

---

* Read before the Pacific Coast Surgical Association, Feb. 25, 1927.

vomiting, apparent abdominal pain and bloody mucoid stools manifested by an infant that previously has been well and happy, and, second, to procrastination or unwise treatment when the diagnosis of intussusception has been made or suspected.

The clinical history outlined in my case portrays two aspects of intussusception concerning which, because of their infrequency, a voluminous literature does not exist. One aspect is that the ileus was caused by a polyp or, more accurately, by a polypoid tumor within the intussusceptum of the ileum; the other, that the recovery of an infant after resection for invagination ileus is a surgical curiosity.

Polypoid formation in the small intestine is apparently so rare that clinicians give slight consideration to the condition, and textbooks on pathology mention it only in passing. This is in contrast to a rapidly increasing literature detailing adenomatous polypi, occasionally single and frequently multiple, in the rectum, large intestine and stomach. According to some clinicians, invagination ileus plays the principal part in the symptomatology of polypoid formation, whatever the location of the polypi, whether the growths are single or multiple, and independent of the age of the patient.

These clinicians suggest an etiologic basis as follows: "The bowel below the tumor block atrophies and stretches and the bowel above incident to peristaltic movements slides on into the gaping segments." Nevertheless, it must be acknowledged that, with or without formation of a tumor, a verified explanation of the modus operandi of intussusception has not yet been given.

That invagination ileus is a dominating feature in the symptomatology of polypoid growths is not borne out by a series of cases of gastro-intestinal polyposis reported by Struthers, of the Mayo Clinic, in 1923. There was not one case of intussusception in his series.

Recovery after resection in intussusception in an infant or young child is seldom chronicled. E. W. Peterson, in 1905, reported in the *Medical Record* what he believed to be the first successful resection for the relief of intussusception. The same author, in 1922, in *Surgery, Gynecology and Obstetrics,* stated that less than a score of successful resections in infants were on record. In the literature are such statements as the following: "In 429 cases of intussusception at St. Bartholemew's Hospital there were nine resections—all nine died," and "In studies of 400 cases by Massart there were eight resections done with eight deaths." I believe that the high mortality in resections is not due to the trauma of resection itself, but is part of the appalling mortality incident to failure to recognize invagination ileus, or to late treatment for the condition.

HUMAN FACTORS IN CLINIC MANAGEMENT

A STUDY MADE IN THE SURGICAL AND FRACTURE CLINICS OF THE OUTPATIENT DEPARTMENT OF PRESBYTERIAN HOSPITAL

MARY K. TAYLOR, A.B., B.S.
UNDER THE DIRECTION OF JANET THORNTON, A.B.
MATERIAL COMPILED BY FLORENCE HARVEY
WITH A FOREWORD BY DAVID C. BULL, M.D.

NEW YORK

FOREWORD

The study of the management of patients in minor surgical care, made in the outpatient department of the Presbyterian Hospital with the cooperation of the Committee on Dispensary Development, illustrates a valuable method for the investigation of the problems of clinic management. It presents, on a statistical basis, certain known faults, considered of minor importance and more or less inevitable with the ever-changing staff of a teaching clinic. The frequency of their occurrence and the amount of harm that they cause had not been realized.

The study shows the degree of disorganization and delay due to teaching as practiced simultaneously with treatment. We have therefore increased the number of surgeons on duty and thus freed the instructor from responsibility for the treatment of patients during the period of teaching. At the same time it was discovered that it was unsafe to assign responsibility to interns, and they are now present for instruction only.

Social problems are shown to be caused or increased by minor surgical disabilities, and we have secured an additional social worker to meet these needs. We have come to a greater realization of the large social element in the handling of patients in the clinic, and feel that lay personnel should be selected on the basis of ability to understand and manage people, an ability which is best developed by training in social case-work methods.

This study throws some light on the moot question of the advisability of general physical examination of all patients. Some of the patients interviewed in this study would have welcomed inquiry into conditions other than the definite surgical complaint; there was something distinctly on their minds—anxiety concerning blood pressure, arthritis or some other question brought up by the propaganda for periodic health examination. We expect that these patients may more readily be singled out with provision of greater privacy and opportunity for concentration

on the person. As an experiment in this direction we have introduced individual treatment cubicles into the plans for the surgical dressing rooms of the new Medical Center.

We realize that this study is one-sided in that it emphasizes only the pitfalls that beset clinic practice. We feel that an analysis of the favorable elements on which success depends in the properly handled cases would be as illuminating and instructive.

It is because we suspect that the faults occurring in certain of our clinics may be duplicated in other institutions that we are glad to have this study published. It presents a mechanism for collecting data on the basis of which existing faults may be detected and technics of clinic management built up.

AIM AND METHOD OF STUDY

Physicians have always recognized the need of understanding not only the pathologic processes of organs and tissues, but also the patient in his aspect as a person. As the practice of medicine has grown more complex, greater cooperation on the part of the patient has become necessary, and at the same time, psychologic methods have been developed to study his personality and to influence his behavior. Meanwhile, there has been an enormous increase in the number of persons applying for outpatient care and in the cost of such care, while modern ideals of medical practice demand more individualized attention for each patient.

The strain the increased number of patients has placed on existing procedures and forms of management has brought to light inadequacies and defects not previously apparent. Thus the problems confronting the administrator of a modern outpatient department have become greater and more varied than ever before. Many of these problems are similar to those of business organizations handling masses of people and endeavoring to give satisfaction to each person. In an effort to meet the situation, business organizations are testing their efficiency by "job analysis" and the formulation of technics—a movement to which impetus was given by the necessity of wartime.

The Committee on Dispensary Development recognized the need for similar tests and study in connection with the administration of medical care in outpatient departments and undertook to make careful observation of the best existing practices and the results achieved in the management of patients.

Aim.—In an effort to arrive at a method by which efficiency in the management of patients could be tested and results evaluated, the question naturally arose, "For what purpose is the clinic run?" If it is assumed that the answer must be, "To give adequate medical care to patients," the next question is, "How do we know whether adequate

care has been rendered? How are we to find out? What conditions make for adequate care?" Except for the reports of visits made, revenue received, cost of care and other items and the study of end-results in the comparatively few cases in which research has been of interest, there is no method of testing and evaluating the service of the clinic as a whole. It is for this reason that physicians engaged in the actual treatment often struggle to care for far more patients than they can treat adequately. They are often supported by assistants chosen because of their willingness to work for low pay and entirely unequipped to manage patients in a clinic. Administrators have been concerned with keeping down the cost of service, and have been unaware that service has not been rendered.

A method of testing and evaluating management of patients was devised, and a study was made by members of the staff of the Committee on Dispensary Development, in 1925, in the outpatient department of the Presbyterian Hospital in New York, with the approval of Dr. Allen O. Whipple, director of surgery, and in collaboration with Dr. David C. Bull, chief of the surgical clinic. A clinic dealing with minor surgical treatment was selected with the idea that the problems of management were simple compared with those of a more complicated general medical clinic previously studied.[1] As will appear, the observations indicated that even in these minor surgical clinics, what may be called the management quotient was high.

Scope.—In making the study, emphasis was placed, not on the management of *disease* nor on the diagnosis and therapy for different conditions, but on the *management of patients,* and on the staff and plant required to serve them. The experience of a number of unselected patients was analyzed. These cases were studied with a view to obtaining a picture of each patient in his social and economic setting and in relation to his disability at the time of his admission to the surgical clinic, throughout the course of treatment, and at the time treatment was discontinued. It was proposed that the study of each case, with interpretation and assistance by the physician throughout the course of treatment, should bring out the patient's disability in terms of discomfort and inability to carry on his usual occupation; a forecast (on date of diagnosis) concerning the outcome expected and the amount of time necessary for treatment and recovery; the plan of treatment; the elements of difficulty and expense entering into the giving of treatment and the giving and carrying out of advice, and a description of the rôle played by the surgical and adjunct services and by the patient and other agencies outside the hospital.

1. Bradbury, Samuel, M. D.: What Constitutes Adequate Medical Service? New York, Committee on Dispensary Development, December, 1926.

It was not possible to carry out this plan entirely, as the physician did not have the time to give the forecast in each case. It also proved impossible to obtain information from all patients as to the cost of their disability in terms of time lost from work.

Method.—One hundred and fifty-five cases—about a tenth of all new cases admitted to surgical and fracture clinics—were studied between January 8 and May 31, 1925. Thirty-five (22.5 per cent) of the patients had had their first treatment for the present disability in the emergency ward. Not all the patients were studied to the end of their treatment, since seventeen were still active when the study was terminated. It was not possible to study all new cases, since the worker was occupied part of the time in observing treatment.

The method of collecting the information was as follows:

The study worker interviewed each new patient on the waiting bench before he was admitted to the clinic for treatment. To afford a natural approach, the worker took the initial history of the disability, unless, of course, the patient had been previously treated in the emergency ward for the same complaint. The history was written directly on the medical record for the physician's use. It consisted of the standard items—chief complaint, duration, present history and past history when indicated. In addition to the history of the present illness, the study worker recorded the occupation and process, wage, composition of the family and its income, time lost from work for present disability and the effect of this disability on the patient's daily life and work. She also tried to get a picture of the general situation of the family with a view to learning of any existing social or health problems.

The worker then accompanied the patient into the clinic and observed and recorded, as far as possible, the treatment and instructions that were given to him, such as operations, dressings, advice and time of return appointment. When he left the clinic, the worker interviewed him again, asked him what advice he had received and whether he understood it, and noted the time of his departure. He was also asked how much time he had to spend en route, what time he had arrived at the clinic and what expense he had for transportation and treatment. This process was repeated on each subsequent visit, and in addition to these questions the patient was asked his opinion of his progress, what difficulties he had experienced in carrying out his instructions and what difficulties had resulted from his disability. All these facts were recorded each time on study sheets kept on each case. In many instances the worker found that the patient did not understand his instructions or wished to ask questions which he had been unable to ask in the clinic. In each of these cases he was referred to the proper person to adjust the difficulty. According to the study worker, the difficulties recorded

are approximately typical in variety and number of those occurring in ordinary practice in these clinics.

The 155 new patients and the 672 visits on which we have based this study represent but a small amount of the work of the surgical clinics and the fracture clinic during five months. These clinics had a total of 14,555 visits, of which 1,380 were the first visits the patients had made for the current surgical complaint. To get an approximate idea of the actual work of the clinics, the observations we have classified should, roughly, be multiplied by twenty, since this study includes only 10 per cent of the new patients and only 5 per cent of all the visits to the clinics. In addition to treating this large number of patients, the physicians, during five months, took part in the instruction of 64 medical students of the College of Physicians and Surgeons, ten nurses from the Hospital School of Nursing and three interns.

Something of the difficulty of the study worker's task may be estimated from the fact that in connection with the 155 patients she held nearly 1,500 interviews with patients alone, making a record of each, and as far as possible observed and recorded almost 2,000 orders. As several of the study patients were present at the same time, and observation sometimes took place in more than one room of the clinic during the same session, it is evident that the record of difficulties experienced is an understatement, and that the facts elicited must be regarded as characteristic rather than exhaustive.

THE PATIENTS

Before following the 155 patients through the clinic, we will first consider them as human beings. We believe that the problems of management that they represent are fairly typical and must be considered by all clinics treating similar groups of patients.

Occupation.—There were ninety-four wage-earners—sixty-five men and twenty-nine women, between the ages of 15 and 65, six of the women were married and had both home and business duties. Half of the men and two thirds of the women wage-earners were not married. Of the remaining sixty-one patients studied—twenty-three were women who were homemakers, twenty-nine were school children, seven were children under school age, one was a young woman dependent because of poor health, and one was a dependent widower of 57.

Nativity.—Ninety-five of the patients (61 per cent of the whole group), were native born; sixty came to America from other lands, and fourteen had difficulty with the English language.

Residence.—Forty-eight per cent of the 155 patients lived within walking distance of the hospital, 42 per cent within the radius of a 5 cent fare, 8 per cent paid a double fare, and two patients made the

trip by train. Eleven patients made at least one visit by taxi because of the severity of their condition.

Economic Status.—From the data which we have on ninety-five patients, we found that 23 per cent had no financial responsibility except for themselves. There is wide variation in the weekly wage received by this group, since one patient received $12, one $40, and six between $15 and $25 and all maintenance.

The remaining 77 per cent of the group of ninety-five patients were members of families whose total income ranged from $10 to $90 a week, and again there was wide variation in the number of persons dependent on the same amount of salary. The most frequent wage was between $30 and $35 (nineteen families), and the number living on this wage varied from two to ten persons, although the family of three occurred

TABLE 1.—*Types of Diagnoses in Cases of One Hundred and Fifty-five Patients Treated in Minor Surgical Clinic*

	(94) Wage Earners		(23) Home Makers		(29) School Children		(9) Other Dependents	
Diagnosis	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Infection	41	44	4	17	8	28	1	11
Injuries	34	36	4	17	19	66	6	67
New growths	3	3	4	17	1	3	..	..
Miscellaneous medical conditions	5	5	3	13	..	..	..	..
Varicose veins	3	3	2	9	..	..	..	..
Unclassified	8	9	6	27	1	3	2	22
	94	100	23	100	29	100	9	100

most frequently (six of nineteen). It is evident that the consideration of wage without responsibilties gives an inadequate idea of the economic status of the family to which the patient belongs, since the ability to purchase medical care varies enormously within the same amount of income.

Surgical Complaint.—One hundred and nine of the 155 patients studied had never been treated at the Presbyterian Hospital prior to the occurrence of the surgical disability. These patients presented greater problems of management, since they required more explanation and more direction. Five were old patients who returned because of a recurrence of a condition for which they had previously been treated in the surgical clinic of the Presbyterian Hospital. Forty-one were old patients of the Presbyterian Hospital previously treated in either the surgical clinic, the medical clinic or the emergency ward, who returned because of a new complaint.

Thirty-five of the whole group of 155 patients had previously been treated in the emergency ward before being referred to the surgical clinic in the outpatient department, because the fixed hours of the surgical clinic did not coincide with their needs.

Disability.—We do not know, of course, all the difficulties the patients encountered because of the surgical conditions from which they were suffering. But we do know that 143 were in pain or discomfort when they appeared on the waiting benches; thirty-five had come in after a sleepless or disturbed night; seven had abnormal temperature; fifteen moved a wounded limb with great difficulty, and five had been obliged to seek the help of others in getting themselves dressed to make the journey.

Sixty-five patients were totally unable to carry on their usual occupation at the time of the first visit, and twenty-nine more could work only part of the time or with greatly decreased efficiency. At least seventeen suffered financial loss from being unable to work. A change in job was made in eight cases during the course of treatment: four patients lost their jobs, three learned that they should seek some different kind of work, and one had to give up her job because her absence to attend the clinic created so much unpleasantness.

Mental Attitude.—Sixty of the patients were in a state of considerable anxiety over their condition or from fear of losing their jobs or part of their pay or because of children left alone at home. Twelve of the whole number had fear of the treatment itself or the strangeness of the surroundings. The trip to the clinic had caused considerable pain to four persons. Two men hoped the waiting time would not be long since they had been working all night as watchmen and were obliged to get back on the job in the afternoon. Twenty-six patients were troubled because relatives or friends were giving up time to assist with housework, care for children or to come to the clinic as escort. The twenty-nine school children regarded the clinic with varied emotions—some were missing examinations and were afraid they would not be promoted; some were afraid the teacher would think they had been playing truant; at least four planned to make the clinic an excuse for a little extra vacation from their labors. Seven working men knew that their employers and fellow-laborers were working overtime to cover their jobs.

Collateral Medical Complaint.—Fifty-one of the patients had other complaints or anxieties in addition to the complaint that brought them to the surgical clinic. Some thought they might as well get "all fixed up at once," and were glad that they had occasion to come to the clinic anyway, so that they might ask care for other troubles. Among these complaints were "colds," "rheumatic pains," "headaches," and "dental defects." Others had deviations from normal health of which they were conscious in varying degrees. Several patients, who had been previously cared for in the ward or other clinics, came back as old friends, but with an embarrassed consciousness that they had not kept the last appoint-

ment. Twenty-seven had never previously sought treatment for these collateral complaints and now wanted advice. Seven had "lapsed" from some other clinic of the Presbyterian Hospital, and now had complaints about the original disability or some new one; seven had recently had outside care for some collateral condition, but had "lapsed" from that care and still had complaints; five were active at the present time in some clinic of the Presbyterian Hospital, and five were under other outside care. Most of these complaints were revealed spontaneously to the worker in reply to her question as to the patient's general health. Others were revealed after the worker had questioned the patient about some condition for which he had been treated previously at the Presbyterian Hospital and described in the medical record.

Social Complaints.—Observation and brief but sympathetic inquiry as to the effect of the surgical condition on the mode of life or the earnings of the patient, revealed that in nineteen of the 155 cases some social problem had arisen from the disability or complicated the care for it. The question of arranging for the support of dependents, or of being supported during the period when earning power was decreased was most important in fourteen of the nineteen cases. Savings exhausted by unemployment, debt for other illness, sickness of other possible wage-earners in the family, and nonsupport by husbands, complicated the situation. Not all the nineteen patients directly revealed the problem that was disturbing them. One infant, suffering from an infection, was dirty and undernourished; the sister who brought the child explained that the mother was sick, and that there was no responsible person to care for the baby. There was obviously a problem in connection with a frightened child who had a fracture of the radius; the mother was irritable and nagging in the clinic, and clearly had no idea of how to handle the child. One mother with an abscess of the finger had sick children at home, and could not care for them and herself at the same time.

In addition to the patients whose surgical condition had served to cause or to emphasize some difficulty at home, twenty-nine more revealed home anxieties which had been troubling them before the surgical condition developed. For example, eight were feeling stress from the unemployment of the breadwinner, five were disturbed and the home disorganized because of illness of other members of the family. Three were worrying about insufficient income for their needs. We have no means of knowing how many more of the 155 patients were facing social problems of some kind, since the information on the twenty-nine cases was not solicited by the study worker, and usually was given by the patient in response to friendly questioning concerning the effect of the surgical disability on daily earnings and life. We can only say that 31 per cent of all the patients studied—twenty-three wage-earners, eight

home-makers, four wage-earning housewives, nine school children, three small children, and one dependent young woman, revealed that there were more or less serious disturbances in their personal lives, although no searching inquiry was made to obtain this information.

Problems of Management.—It was not the purpose of this study to analyze the surgical problems in the cases studied. As our interest was in the care of the patients as persons, we have omitted all reference to problems of surgical technic, and such difficulties of organization and maintenance of the clinic as financing, selection of a staff, etc. Certain problems in addition to those confronting the patients themselves (which are, of course, also of concern to the clinic) were brought to our attention.

Management of these patients was made more difficult in fourteen cases by the fact that the patient's knowledge of English was limited. Two patients seemed of such low mentality that it was almost impossible to make them understand instructions; two made contradictory statements; at least one exaggerated and five were so terrified as to prevent them from asking questions or giving necessary information. A number of the patients were deaf, and one so much so that he had to be communicated with in writing. One was intoxicated. One was so discouraged by life in general that he felt there was no use in carrying out treatment. Six had to be urged to tell the physicians of symptoms or complaints which were worrying them. One knew more than the physician as to what form of treatment was desirable. Two sought other care simultaneously with care given at the clinic, as they did not feel complete confidence in the physician. Four children came for treatment unaccompanied by responsible persons in instances in which operation or instruction was necessary. In the case of seven children there was evidence of neglect or carelessness at home—the parents of one refused permission for an operation. At least one patient had no facilities at home to carry out the treatment ordered by the clinic. In one case, dire necessity forced a man with dependents to return to work against the physician's advice. One patient was sent in from another hospital without any report as to previous treatment. Four did not seek care at the clinic until considerable time had elapsed after the injury.

Treatment.—In the management of the group of 155 patients there were three definable types of clinic orders. The first type was the form that implied the consent of the patient, but did not involve his active participation, such as bandaging and laboratory tests. Management in these cases sometimes involved giving the patient some instruction as to how he was to hold his arm or the need for remaining quiet, but in general some member of the staff took the active part. One hundred per cent of the patients were affected by this group of 699 clinic orders.

The second type of order was concerned with the return of the patient, or with carrying out treatment in some other department of the hospital or in another institution. Management of the patient through this administrative type of order involved some instructions and explanation of the importance or desirability of carrying out the order. Nearly 100 per cent of the patients received such orders, of which there were 994 in all.

For example, forty patients had to be referred to the operating room, with explanation and reassurance, direction to the place, and often instruction as to the signing of anesthesia permit, arrangement for relatives to accompany them home or other assistance. Seven had to produce specimens of urine or go to the laboratory for blood counts. Forty-six had to be directed to the roentgen-ray department and to have supplementary payments adjusted. Forty-seven had to procure medicines or apparatus, which made it necessary to direct them to the pharmacy, social service department or commercial concerns in addition to explaining to them the use of the article prescribed.

Thirty-six patients were referred or transferred to other clinics or departments in the Presbyterian Hospital, often to more than one department, since seventy-three orders were issued among the thirty-six patients. Three were admitted to the wards. Ten were referred for care outside the Presbyterian Hospital, and had to be given credentials and instructed as to the location of the clinics and at what hour they were to go. Five hundred and eighty return appointments were given in the clinic, which presumably involved some consultation of the patient's preference as to the hour and an explanation of the appointment card. A reduction of the fee was granted in fifteen cases after discussion of the patient's ability to pay. Eight loans were made to patients who had no money with them.

The third type of order was given to the patient to carry out at home as part of his treatment. Eighty-five of the group of 155 patients were given such orders, thirty different orders being given in all. Some of these were in the form of prohibitions—as in forty-nine cases, orders not to go to work—and these involved inquiry into the kind of work, telling the patient the order and notifying him when he could modify or discontinue it. Other orders involved instruction in addition to notifying the patient when he could discontinue the treatment. Examples of such orders are: hot soaks ordered in twenty-seven cases; flaxseed poultices ordered in nine, and internal medication ordered in twenty-four. Questioning of the patient on each visit as to how the instructions were being carried out was also implied in this group of orders. There were 189 such orders.

To summarize, 1,882 orders were given in connection with the 155 cases (not including discontinuance orders) and 1,183 (63 per cent),

involved instruction and the securing of the active cooperation of the patient. Six hundred and ninety-nine (37 per cent) implied the consent of the patient, but did not involve any direct instruction or any participation of the patient. The 1,882 orders did not include any clinic activity prior to the examination of the patient by the physician, and to make a complete total one must add activities in connection with admission, assessment, making out of record, taking of history and the clerical work made necessary by handling the record on each visit.

TABLE 2.—*Clinic Orders to Patients to Be Carried Out at Home* *

	Patients	Carrying Out			
		In Full	Partly	Not	Unknown
Total	189	113 (60%)	21 (11%)	18 (10%)	37 (19%)
Refrain from usual occupation	49	39	4	0	6
Rest part affected	13	8	3	0	2
Hot soaks	27	14	3	2	8
Stay in bed	4	2	0	1	1
Icebags	4	2	1	1	..
Apply heat	4	1	..	..	3
Flaxseed poultices	9	2	5	1	1
Keep dressing wet	12	8	1	3	..
Protect with dressing	1	1	..	..	..
Force fluids	1	..	..	1	..
Avoid jumping in school	1	..	..	..	1
Use cane	1	..	..	..	1
Use crutches	1	1	..	..	..
Wear suspensory	1	..	..	..	1
Wear different kind of shoe	1	..	..	..	1
Cut toe-nail straight across	1	..	..	..	1
Keep warm	2	1	..	..	1
Keep hand dry	2	..	1	..	1
Use rubber glove	1	..	1	..	..
Have head shaved	1	..	..	1	..
Stay out in air	1	..	..	..	1
Drink eight glasses water	1	..	1	..	..
Keep leg elevated	1	..	..	1	..
Do exercises	1	..	..	1	..
Bring letter from physician	1	..	..	1	..
Apply external medication	13	12	..	1	..
Use mouth wash	2	1	..	1	..
Take internal medication	24	21	..	3	..
Wear elastic stockings	7	..	1	..	6
Wear elastic bandages	2	..	..	..	2

* The thirty different kinds of advice were given to eighty-five patients.

ACCOMPLISHMENTS OF CLINIC

With what degree of success were the problems dealt with? To what extent were the orders carried out? What were the outstanding difficulties experienced along the way by both patient and clinic?

Disposition of Cases.—Ninety of the 155 patients (58 per cent) carried on their treatment for the original surgical complaint until discharged by the clinic either as "improved" or to seek care in other clinics of the Presbyterian Hospital or in some other institution; sixty-two (40 per cent) lapsed, and three (2 per cent) were still active after a year. The "discharged improved" patients had been under care an average of fourteen days, during which they had averaged 5.8 visits.

The "lapsed" patients had been under care an average of sixteen days and had averaged 4.4 visits before lapsing. The "transferred" patients had averaged 1.9 visits in 5.3 days in the surgical clinic to which they originally applied.

We have incomplete information on the sixty-two patients who did not finish their treatment. Four of the whole group of sixty-two wrote in response to a follow-up that they were "cured" and had returned to work. Using the last note on the chart and the study worker's notes as a basis, the chief of clinic was able to estimate the condition of fifty-one of the sixty-two "lapsed" patients. He considered that forty-one were improved, six probably improved and only four not improved. No attempt was made to follow up the fifteen patients who were transferred to other care after the contact was established, so we do not know how many of these subsequently "lapsed."

Collateral Medical Complaint.—Of the fifty-one patients who had collateral complaints (several of them more than one) at the time they were admitted to the surgical clinic, only ten were already under treatment; ten others were considered and treatment arranged for spontaneously by the physician in the surgical clinic. In forty-one cases little or no consideration was given to the collateral condition by the physician in the surgical clinic, and this was usually either because he did not read previous entries on the charts of old patients, or because he did not read the entire history as taken by the study worker and written on the chart. Thirteen of these cases were called to his attention either directly by the study worker or by the patient after being urged by the worker, and treatment was arranged. Eighteen patients who were not already receiving treatment left without any care for the collateral complaint. We cannot say how many of these were not considered by the physician, but it is our impression that in the majority of cases no inquiry was made of the patient, although the complaint was noted on the chart by the worker when she took the history.

On the other hand, some collateral medical conditions which had not been revealed to the study worker by complaints of the patient were discovered or suspected by the physician in the clinic, since twenty-three patients besides the twenty-three already described were transferred or referred by the physician to other departments or institutions, and some of these patients were referred or transferred for care of collateral conditions.

Collateral Social Problems.—At least forty-eight of the 155 patients were worrying about some social problem which, in nineteen cases, was created by, or connected with, the surgical disability. In the majority of cases it was never elicited by any one officially connected with the

clinic, since no social inquiry was made of the patient except the routine question as to his ability to pay the fee.[2]

Nine of the forty-eight patients reached the social service department, only four of them having been referred spontaneously by the clinic. In addition to the nine, seven who had no problems were referred to the social service department to purchase apparatus, so that the total contact of this department was with sixteen of 155 patients, and only eleven of these (7 per cent of 155) had a spontaneous contact.

Carrying Out of Orders.—(*a*) Some of the orders did not involve the active cooperation of the patient, but had to be carried out by some member of the clinic staff. Of these 699 orders (of which 557 were for dressings), 98 per cent were carried out by the staff. No attempt was made to estimate the quality of the performance, except in a few cases in which some difficulty was caused the patient.

Subordinates were handicapped in carrying out orders in several cases by the fact that they had not received direct instruction from the physician, since he had dictated his orders and the record was not clear. The physician was often inaccessible, because he was teaching or operating.[3] We found a number of instances in which subordinates acted without instruction, and in the majority of cases it was because the physician was inaccessible.

(*b*) In carrying out the group of orders involving some cooperation on the part of the patient, two elements are included: first, a clear understanding by the person who was to give the order, and second, comprehension by the patient of what he had to do, and its importance. Seventy-nine per cent of the 1,183 orders involving cooperation on the part of the patient were carried out in full, according to the best information at hand. For example, sixty-five of the seventy-three orders were carried out in the case of patients referred or transferred to other clinics or departments in the Presbyterian Hospital, and eight of the ten orders that patients be referred or transferred to other institutions. We do not know what took place in the case of the other two. Thirty-eight of forty operations that were recommended were performed, and in sixty-four out of sixty-five cases roentgenograms were made. In 4 per cent we have no information; 17 per cent were known not to have been carried out in full.

---

2. At the time of the study one social worker was on duty in the outpatient department and, as a routine, all patients who were referred for admission to the ward or for whom apparatus was ordered, were sent to her desk for inquiry and assistance, if necessary. Other patients were referred to her at the discretion of the physicians in the clinic or of the superintendent.

3. In one general surgical clinic the physician not only administered treatment, but gave instruction to students, operated, was on duty at certain hours for admitting new patients, and was also on duty in the children's clinic.

(*c*) The 189 orders given the patients to carry out at home in connection with the treatment are included in the 1,183 that we have just analyzed. The study worker was obliged to rely on the patient's statement, of course, in judging the degree of accuracy with which orders

TABLE 3.—*Analysis of Clinic Orders*

	Individuals Affected	Ordered	Carried Out	Not Carried Out	Unknown
Orders Not Requiring Instruction of the Patient.....Total	..	699	684 (98%)	15 (2%)	..
Surgical dressings	92	557	547	10	..
Pressure bandages	7	14	14	..	..
Strapping	9	18	18	..	..
Splint	7	13	13	..	..
Sling	3	6	6	..	..
Cast	2	2	2	..	..
Soaks in clinic	3	3	2	1	..
Irrigation with surgical solution of chlorinated soda	2	2	2	..	..
Massage in clinic	4	21	20	1	..
Baking in clinic	3	3	3	..	..
Antitetanus serum	6	6	5	1	..
Autogenous vaccine	1	9	9	..	..
Epinephine	1	1	1	..	..
Cultures	23	23	22	1	..
Wassermann tests	11	11	10	1	..
Letter or report	10	10	10	..	..
Orders Requiring Explanation or Instruction (in clinic)..Total	..	994	820 (82%)	165 (17%)	9 (1%)
Operations	40	40	38	2	..
General anesthetics	27	27	27	..	..
Local anesthetics	9	9	9	..	..
Urinalysis	7	7	7	..	..
Blood counts	2	2	2	..	..
Roentgen-ray examination	46	65	64	1	..
Securing medication and apparatus					
Internal medication	24	24	21	3	..
External medication	13	13	12	1	..
Elastic stockings	7	7	1	..	6
Elastic bandages	2	2	..	1	1
Crutches	1	1	1	..	..
Patient referred or transferred to other care	46				
In Presbyterian Hospital	36	73	65 (89%)	8 (11%)	..
Baking and massage clinic	..	19	18	1	..
Radiotherapy clinic	..	4	4	..	..
Wards	..	3	3	..	..
Medical clinics	..	7	6	1	..
Skin clinic	..	2	2	..	..
Dentistry or oral surgery	..	10	5	5	..
Other surgical clinics					
Women's	..	1	1	..	..
Fracture	..	3	3	..	..
Surgical diagnostic	..	8	8	..	..
Social service	..	16	15	1	..
Outside Presbyterian Hospital	10	10	8 (80%)	..	2 (20%)
Manhattan Eye and Ear	..	3	3	..	..
Orthopedic Hospital	..	3	2	..	1
Vanderbilt Clinic	..	1	1	..	..
Neurological Institute	..	1	1	..	..
Cornell Clinic	..	1	..	..	1
Compensation physician	..	1	1	..	..
Appointments.....Total	..	683	534 (78%)	149	..
Appointments given in clinic	138	580	483 (83%)	97	..
Written appointments	64	103	51 (50%)	52	..
Loans	8	8	8	..	..
Admitted without paying	7	8	8	..	..
Reduced fee	15	15	15	..	..

were carried out at home; direct observation might have revolutionized some of the figures. In this group, the largest number of patients given any single direction was forty-nine, who were told not to engage in their usual occupation. Thirty-nine of these, we believe, carried out the order

in full and four in part; we have no information concerning six. Twenty-seven were ordered to apply hot soaks; fourteen did as directed; five failed to do so; information is lacking in eight cases. A summary of this whole group of orders given to the patient to carry out at home showed that 60 per cent were probably carried out as directed, 21 per cent were not carried out, and information is lacking on 19 per cent.

PROBLEMS FACED BY PATIENTS

Difficulties Encountered.—Fifteen of the 155 patients went through the course of treatment without any difficulties being noted. Most of the difficulties appear to have occurred during the first visit, which seems to indicate that the greatest need of attention to managing the patient is on admission and throughout the first visit.

The principal difficulty experienced by patients was due to lack of adequate instruction. Forty-eight of the eighty-five patients who were given advice to carry out at home revealed to the study worker that they did not fully understand the advice itself or were uncertain as to how long to continue it. For example, in twenty instances the correct use of soaks was not fully understood; in twenty-five instances, patients did not understand whether they could go on with their regular occupation or not; four more had received conflicting advice from physicians as to whether they should work.

Instruction of patients as to other orders was also inadequate in thirty-one instances. This failure to instruct the patients was aggravated by the fact that it was difficult for them to ask questions of the physician in clinics in which the physician passed from patient to patient dictating his notes, and then left the room to teach or to operate.[4] The patient hesitated to interrupt, and had no subsequent opportunity to ask about his condition or treatment. Aides had the same difficulty, and often had to choose between making decisions without authority and delaying patients who could not afford to spend any more time in the clinic. Ten instances were noted in which patients were seriously disturbed but were unable to speak to the physician.

The appointment system, while on the whole advantageous to the patients, raised such problems as the following: hardship caused patients by not calling them for treatment in accordance with the appointment; giving appointments at times inconvenient for patients (fourteen cases); long waits (162 instances). A follow-up of broken appointments was

4. In the general clinics the patients were called in to the treatment rooms in groups, and the physician passed from patient to patient examining and dictating at the same time. The aide kept the records on her desk and wrote the dictation directly on them. The nurse followed the physician, doing the dressings he had prescribed. She consulted the medical record, if necessary.

left largely in the hands of the aide, since the physician seldom had time to examine the charts of patients who failed to come as directed. The decision concerning follow-up was made by the physician in only nineteen of sixty-two "lapsed" cases. Five cases were lost because the appointment was not properly recorded and the record was not reviewed when the patient failed to return. The aide made the decision to drop thirty-eight of the cases.

Another group of difficulties was connected with the financial management of patients. In thirteen instances, fees were collected from patients who, in the opinion of the study worker, were not able to pay; in six of these cases she reported her observations to the superintendent's office, and revision of the rate was made; in the seven cases not reported no revision was made. It was chiefly the long duration of the treatment or disability which made revision necessary, and this was not determinable by the admitting clerk, who fixed the rate at the patient's first visit. In six cases the study worker felt that the patient was able to pay for private or pay clinic care; one of these she reported to the superintendent's office, and adjustment was made. One patient continued care in the emergency ward after the out-patient department had notified him that he was ineligible for care in the clinic and advised him to seek private care. In three instances, full fees were collected after the patient had been notified that reduced rates or free care would be granted. In two cases, no refund was made after the patient had been charged for an operation which was postponed. Two compensation cases were not discovered on admission.

Many difficulties were related to the recording of clinic orders or observations. These seldom affected the patient directly at the time, as did most of the other "difficulties" we have noted, but were rather potential sources of difficulty which might hamper his care in the future.

In 168 instances, recording of diagnosis or advice was incomplete or inaccurate.

While no attempt was made to give the patient an idea of the probable duration of his disability, the tendency on the physician's part to underestimate this might reasonably be noted here as a potential cause of diffifulty. Because of the pressure on the physician's time in the clinic, little effort was made to obtain a forecast from him as to the length of time the patient must remain under treatment or the number of days that he would be unable to do his usual work, but the complete data we have on thirty-one cases seem to show that the physician's tendency was to underestimate the time necessary for treatment. The average time estimated was nine days, while the thirty-one patients were actually under treatment an average of fifteen days. The time in

eight cases was estimated correctly within a day, in four it was overestimated and in nineteen underestimated.

We have data on only seventeen cases about the length of time the patients were unable to work, but here we find the same tendency—the average time of actual unemployment was eleven days; the average time estimated by the physician was six and one-half days. The time was correct within a day in two cases; in six it was overestimated and in nine underestimated.

The difficulties which have been discussed in this and the foregoing sections are not exhaustive. Nor have we, in this part of the discussion, stressed the degree to which these difficulties were rectified. In some cases they were discovered and adjusted by the clinic staff before the patient left; in others, the patient was encouraged by the study worker to ask the proper person to make the adjustment; in a few, the study worker herself reported the trouble to the proper person or made the necessary explanation.

TABLE 4.—*Average Cost of Treatment at Clinic Rates for Various Number of Days* *

	Complaint	Days	Cost
30	Infections	17	$4.68 each
19	Injuries (no fractures)	9	2.08 each
5	New growths	14	3.12 each
3	Miscellaneous medical conditions	13	5.75 each
4	Varicose veins	13	3.81 each
6	Unclassified	11	2.61 each

* This cost includes visits, roentgenograms, baking and massage, elastic stockings and other special items. The rates of the clinic were 50 cents a visit.

The importance of the difficulties by no means centers in their number, since many more probably occurred than were brought to the attention of the study worker, but in their kind and the fact that they occur at all. The outstanding failure seems to be in the instruction of the patient as to his part in the care of his condition and in delegating to subordinates responsibilities which they are not equipped to handle.

Cost.—Although the material is not complete, we have some evidence on which to base an estimate as to what the treatment has cost the patients in money and time. The figures which follow are based on 138 cases.

The average *actual* cost to these patients, obtained by subtracting fee remissions, unrepaid loans, reduced rates, etc., was as follows:

Infections	$3.98	Miscellaneous medical conditions	$5.75
Injuries	1.82	Unclassified	2.61
New growths	3.02		
Varicose veins	3.69		

The average cost to these sixty-seven patients at clinic rates was thus $3.64; they actually paid an average rate of $3.24. This was distributed over an average of 5.8 visits in fourteen days. From the data on fifty-six "lapsed" cases we found that the average cost at clinic rates, prior to the "lapsing," was $3.04; the patients actually paid an average cost of $2.36, which was distributed over an average of 4.4 visits in 16.2 days. The fifteen patients who were transferred were considered only until they left the clinic to which they first applied. The average cost at clinic rates was $2.49; the average amount paid was $2.09. To all these averages must be added an average of 43 cents for transportation.

To summarize, the average cost to the 138 patients at full clinic rates would have been $3.26; they actually paid an average of $2.75 (84 per cent of the full rate). To this must be added 43 cents for transportation, making an average cost of $3.18 for each person.

These averages do not include seventeen cases (11 per cent, which were not completed during the time of the study from Jan. 8 to May 31, 1925), and it is undoubtedly among this 11 per cent of the cases that we find the long drawn out treatment, with corresponding elements of expense and time. The cases include such diagnoses as fractures and ulcers of the leg, and had figures been available they would have greatly affected the averages. The problems of financial management would appear much increased if studied throughout the whole course of treatment of these long-time cases.

Time.—From data on 674 visits made by 132 patients, we found that the average length of time spent in the clinic on each visit, reckoned from the time the patient entered the door of the outpatient department to the time he left, including operations and visits to the roentgen-ray department but none for baking and massage, was seventy-eight minutes. To this must be added an average of forty-eight minutes for the time spent in going back and forth from home to clinic, making a total average of two hours and six minutes spent by each patient in making each visit.

By studying the figures for a number of first visits, we found that they averaged one hour and forty-eight minutes in the clinic, as compared to one hour and eighteen minutes for all groups of visits. First visits without operations or the employment of the roentgen ray averaged one hour and thirty-one minutes; first visits with operations averaged two hours and fifty-four minutes; first visits with the use of the roentgen ray averaged two hours and thirty-four minutes. It is evident that it requires careful management to avoid unnecessary delays to the patient on the first visit.

Study was made of 185 instances in which the patient was kept waiting an exceptionally long time, so that his time in the clinic reached or

exceeded two hours, and the major cause of delay was noted when it was evident. We found that in twenty-three of the 185 instances, the delay was due to operation, employment of the roentgen ray, waiting for massage, consultation or going to other departments, and was more or less unavoidable. In forty-eight cases more, the major delay was due to lateness or absence of the regular physician, or to the fact that he was out of the clinic. In two cases, absence of an aide caused the delay. In eleven, the long waiting time was due to the shortage of screens, or to the fact that the patient had to wait while the nurse left the clinic to get some article necessary for treatment. Teaching caused the long waiting time in forty-seven cases, and in only seven of these was the patient himself the subject of the teaching. In nineteen cases the delay was caused by failure to requisition or to send charts or by the failure of the aide to send for the roentgen-ray report or plate before the patient arrived. In two cases, the patient was forgotten and left behind the screen. In thirty-three cases, the causes of delay were too complicated to list—usually consisting of lateness in starting the clinic, and general slowness throughout which affected the appointment system and was reflected in the waiting time of patients coming later in the morning.

SUMMARY

Effective Control of Most Cases.—The outcome and disposition of the 155 cases show that the clinic studied exercised a relatively high degree of case control. This was proved by the fact that 58 per cent of the patients carried on their treatment until discharged by the clinic, 2 per cent were still active at the end of a year, 26 per cent were estimated by the chief of clinic to have been sufficiently improved by treatment to consider themselves cured, 4 per cent were probably improved and only 3 per cent were considered not improved. Data on which to base a decision were lacking in 7 per cent. The belief that most of the "lapsed" patients were improved was substantiated by the fact that they had made an average of 4.4 visits before "lapsing," while in completed cases the patients had averaged only 5.8 visits.

Another proof of the high degree of control exercised by the clinic may be deduced from the high percentage of appointments kept by the patients. Seventy-eight per cent of all appointments made (including those given patients in follow-up letters) were kept. The "discharged improved" patients kept 94 per cent of all appointments; the "lapsed" patients, 61 per cent. Written appointments were sent to the latter group.

Reasons for Effectiveness.—The high degree of case control is due to the effective organization of physicians and adjunct services, and to the adequate system of records.

The use of a system of appointments made it possible to regulate attendance and to review the records of patients not reporting as directed. Clinic clerks or "aides" assisted with the management of the patients and attended to the clerical work connected with the system. Follow-up by letter or by visit from a social worker might be carried out at the physician's discretion.

The medical record was of the "unit" form so that record of previous treatment of the patient in any department of the hospital—outpatient, social service, ward or laboratory—was complete, and all the previously discovered facts concerning the patient's physical or social condition were available to the physician. The notes made in any department showed the condition of the patient at his last visit to that department, and the disposition of the case, giving the date that the patient was expected to return if the case was still open or designating it as "patient discharged," "lapsed—no follow-up necessary" or "lapsed," with the physician's instructions concerning follow-up.

Low Cost.—The cost of clinic care to the patient in time and money was low. The cost at clinic rates to all patients studied (including those who lapsed and who were transferred) was $3.26, of which, after allowing for remitted fees, an average of $2.75 was paid. This amount with carfare made an average cost of $3.18 a person.

The amount of time spent in the clinic by the patients compares favorably with that which they would have had to spend for private care—although the fact that the clinic was held in the morning made the loss of time more important to working people who could have sought private care at more convenient hours. An average of one hour and eighteen minutes was spent on each visit, which included actual treatment as well as waiting time. First visits when operations were not performed or the roentgen ray used averaged one hour and thirty-one minutes.

Most Patients Satisfied.—When possible, the worker secured from the "discharged improved" patient an opinion as to whether he considered the treatment successful. Forty-five of the forty-nine patients interviewed believed themselves cured; three thought their condition was unchanged but had confidence that the apparatus secured would help them; only one was dissatisfied. Several expressed appreciation of the treatment, and the interviewer received the impression that the majority of the patients were pleased with the interest that had been taken in them and satisfied with the service they had received.

Explanation of Treatment Necessary.—Although the conditions for which the patients were treated were generally considered "minor," it was shown that they caused considerable disturbance in the lives of these

persons, and also that treatment entailed a large number of explanations and instructions which required attention to the psychologic and social elements of management in order to render the treatment effective. The difficulties experienced by the patients indicate that not enough attention was paid to making instructions clear, since 56 per cent failed to understand directions for home treatment, either as to the process itself or as to the length of time it should be continued.

Undiscovered Social Problems.—The principal difficulties experienced by the patients were due in general to the fact that they were not sufficiently individualized. In particular, the general health and social aspects of each patient were not usually discovered unless the patient took the initiative, and psychologic factors in management were neglected.

The question might well be raised as to whether it is the responsibility of a minor surgical clinic to discover and handle these situations. Clinic management has not yet developed to the point at which special clinics are organized and run in such a way that the constitution and general condition of each patient can be studied. Full histories are not taken; the staff is inadequate.

Planning of Clinic Procedure Required.—In connection with these collateral medical and social complaints it would appear that even a brief inquiry into the patient's health and social situation, and some history of his previous medical experience, made at the time of his admission to the outpatient department and assignment to the clinic for treatment, would give the necessary clues for instigating medical and social care, and would remove from the special clinic the burden of inquiry.

A plan of clinic procedure that would allow a minimum of three or four minutes of the physician's time for each case, and give the patient an opportunity to ask questions, would go far toward removing blurred impressions and misunderstandings. The form of clinic management employed in the clinic for cases of fracture, in which the physician, with the chart before him, called in one patient at a time and treated him, led to greater concentration and better individualization of the patient. The other form of clinic management employed in the general surgical clinic, in which the patients were called in to the treatment room in groups, and the physician passed from patient to patient, dictating his notes as he went, made possible the direction of treatment for a larger number of patients, but did not make it possible to focus attention on one person. Had this physician-procedure been supplemented by a more responsible aide service, it might not have caused so many difficulties; as it was, explanations and follow-up were left in the hands of clerical workers who were not equipped to perform that part of the clinic care.

CONCLUSION

From such studies as this, we are beginning to realize the meaning and the possibilities of scientific management of the patient in clinics. Further observation will reveal further needs, and only such observation will make it possible to appraise the service rendered, to analyze and to develop technics of management, and to train personnel competent to support and supplement the physician in carrying on the practice of medicine among patients in the clinic.

APPENDIX: REPORT OF A TYPICAL CASE

Case XYZ, 1,000,000 has been selected as typical, and the report shows the form in which the material was collected and recorded. The summary sheet was made out on the first visit of the patient, except for the statistical summary of the time and expense involved, which was added after the case was completed. The sheet on which each visit was recorded was written up after each visit, from notes made by the worker while the clinic was in session, supplemented by study of the chart after the clinic was over. The case is copied exactly, except that on the original visit sheets the time and cost of each visit appeared beside the orders and difficulties. For convenience in reproduction, they are given separately.

SITUATION PRESENTED

Patient's Name, XYZ
Patient's Number, 1,000,000 — How referred, New patient — Doctor H.
Age, 27 — Man — Single — Nativity, United States — Occupation, hall boy

Diagnosis: Acute lymphadenitis of superficial and upper deep cervical lymph glands.

Problem faced (including disability): Acute lymphadenitis complicated by infected root of tooth in upper jaw and temperature of 100.3 F. Operative procedure involved and temporary bed care, with supervision and treatment in surgical and dental departments. Temporary total inability to work.

Forecast:
Recovery, 2-3 weeks
Treatment, 2-3 weeks
Pain, 24 hours after operation
Work, 5 days total inability to perform usual occupation after operation

Proposed plan of treatment:
Bed, soft; diet, forced fluids
Dentistry
Operative procedure when condition has broken down
Dressings, and supervision by surgical clinic

Social and economic situation:
Patient, a hall boy, alternating shifts. Earns $5 a week and $3-4 a day in tips
Patient and mother occupy an apartment
Patient's brother in good business in New Jersey

Summary:

Length of treatment in clinic		10 days
Visits		10
Surgical clinic	6	
Dentistry	1	
Oral surgery	3	
Time to and from clinic		3 hours
Time in clinic		5 hours 16 minutes
Time lost from occupation for disability		13 days
Before admission	3 days	
After admission	10 days	
Cost of treatment in clinic		$6.75
Roentgen ray	$2.75	
Admission	4.00	
Car fare		.60

Cost of time lost from work, unknown
Broken appointments, 0
Disposition, discharged improved

SITUATION PRESENTED—Continued

Patient's Name, XYZ
Patient's Number, 1,000,000
Age, 27 Man Single
How referred, New patient
Nativity, United States
Doctor H.
Occupation, hall boy

XYZ 1,000,000 Date 1925	Advice and Treatment	Agent	Difficulties	Overcome? Agent?
3/11	(1) Refer dental department	(Advice given by doctor)	Patient very nervous, weak and shaky; seems only fairly bright	Mother is intelligent
Men's surgical clinic	(2) Go home to bed (3) Forced fluids (4) Flaxseed poultices (5) Soft diet (light) (6) Return to surgical clinic, 3/12		Voice shakes during interview	
			Never before ill; does not take the advice to go to bed seriously; mother says it is hard to keep patient quiet	Worker impresses on patient the importance of following instructions
			Patient's mother much upset and worried about patient's condition	Worker advises her to talk with doctor, who explains that diagnosis is not absolutly clear; possible tuberculous
			Mother does not understand what patient can eat	Doctor explains patient can have light diet; soft boiled eggs, toast, soups, milk, stewed fruit are permitted
			Mother does not understand how to treat patient at home	Doctor explains patient is to go to bed and have flaxseed poultices, which mother says she knows how to make
			Aide does not consult doctor as to urgency of dental appointment and gets appointment for next day	Worker asks doctor who says patient should see dentist before going home to bed Aide arranges appointment for same morning
			Doctor did not dictate return appointment to aide	Worker asks doctor
3/11 Oral surgical clinic	(7) Roentgenogram of teeth (8) Return to dental department, 3/16	Dental Roentgen-ray department	Patient not directed to cashier with roengen-ray slip	Worker directs
			Patient not directed to dental roentgen-ray department	Worker directs
	2 Repeated 3 Repeated 4 Repeated 5 Repeated	Worker visiting home	Observations on home visit made by worker and reported to doctor	
	(9) Do not eat too much food until temperature subsides		Patient not in bed at 5:30; sitting up	Worker persuades patient to go to bed
			Patient has drunk only 2 glasses of water	Worker emphasizes importance
			Patient had for lunch bowl of beef tea, 2 soft-boiled eggs, tea, toast, stewed prunes, and crackers	
			Mother has steak ready to cook for supper	Worker dissuades mother from giving patient steak, and explains again doctor's advice about light diet
			Mother lay down and went to sleep after mixing flaxseed. Patient was keeping poultices hot by laying alternately in dry, hot frying pan, and then applying. Poultices were entirely dry	Worker explains again process of making poultices, stressing need of moisture as well as heat
			Brother who is visiting patient is discouraging him from going to bed by saying it will make him weak. Mother gives in to patient's wishes	Worker talks with brother and mother, and explains importance of following doctor's advice

SITUATION PRESENTED—Continued

Patient's Name, XYZ
Patient's Number, 1,000,000 — How referred, New patient — Doctor H.
Age, 27 — Man — Single — Nativity, United States — Occupation, hall boy

Date	Advice and Treatment	Agent	Difficulties	Overcome? Agent?
3/12	2 Repeated	Surgical clinic doctor	Patient late in coming to clinic because of weakness	
	3 Repeated			
	4 Repeated			
	5 Repeated		Patient felt very sick in night	Mother kept poultices on all night
	9 Repeated			
	(10) Return to oral surgical department 3/13		Roentgen-ray report not sent from dental department. Surgery aide did not look up	Worker suggests report be shown doctor. Aide gets it, and reports dental department felt tooth should be extracted as soon as possible
	(11) Return to surgical clinic 3/13			
			Aide changes oral surgery appointment from later date, but does not record change on chart	
			Patient's mother still disturbed over condition. Says she was told elsewhere that he had tuberculous throat	Doctor explains that this is possible but not probable
3/13 Oral Surg.	Removed upper left first molar; roots infected; curetted	Oral Surg.	Patient late in arriving Mother states patient felt too weak to get up	
	(12) Return to oral surgical department		Patient came to surgical clinic first as he did not understand appointment	Worker directs him to oral surgery
3/13 Surgical clinic	2 Repeated? (no record)	Surgical clinic	No return appointment recorded on chart	Aide states patient given reappointment for 3/14
	3 Repeated? (no record)			
	4 Continue			
	5 Repeated? (no record)			
	9 No record			
	(13) Return to surgical clinic 3/14			
3/14 Surgical clinic	3 Continue? (no record)	Doctor		
	4 Repeated			
	(14) Return to surgical clinic 3/16			
3/16 Oral surgery	Remaining piece of tooth extracted	Doctor		
	(15) Return to oral surgery 3/20			
3/16 Surgical	3 Continue	Doctor Aide	Patient asks to have surgical clinic appointment changed to correspond with next oral surgical department appointment Aide does not consult doctor about change of appointment	Appointment changed by aide
	(16) Return 3/19 (changed to 3/20)			
3/20 Oral Surg.	Roentgen ray of tooth	Dental Roentgen-ray		
3/20 Surgical clinic	3 Continued (implied)	Doctor	Continued absence from work	Employer wishes patient to return as soon as possible
	(17) Return to dentist			
	(18) Discharge			
	(19) Return to work Discharged improved		Patient did not pay any admission to surgical clinic. Aide did not request cashier's receipt	

TABLE 5.—*Time and Cost Summary on Case XYZ 1,000,000*

		Time of Patient			Cost to Patient			
	Date	Time to and From Clinic	Time in Clinic	Other Time Lost From Work	Cost Transportation	Cost in Clinic	Cost in Time Lost From Work	Other Cost
Surgical clinic	3/11/25	30 min.	85 min.	4 days before admission	$0.10	$0.50	Unknown	None
Oral surgery	3/11/25	..	..	.....	.....	0	.....	Roentgen-ray examination $2.50
Surgical clinic	3/12/25	30	23	1 day	0.10	0.50	Unknown	
Oral surgery	3/13/25	30	90	1 day	0.10	0.50	Unknown	
Surgical clinic	3/13/25	..	5	.....	.....	0.50	Unknown	
Surgical clinic	3/14/25	30	30	1 day	0.10	0.50	Unknown	
Oral surgery	3/16/25	30	30	2 days	0.10	0.50	Unknown	
Surgical clinic	3/16/25	..	13	.....	.....	0.50	Unknown	
Oral surgery	3/20/25	30	30	4 days	0.10	0.50	Unknown	Roentgen-ray examination $0.25
Surgical clinic	3/20/25	..	10	.....	.....	0	Unknown	
		3 hrs.	5 hrs. 16 min.	13 days	$0.60	$4.00	Total cost	$2.75 7.35

ORGANIZATION AND ADMINISTRATION OF CLINICS IN THE OUTPATIENT DEPARTMENT OF THE PRESBYTERIAN HOSPITAL*

Plant.—The greater part of the space in the outpatient department of the Presbyterian Hospital was apportioned during the morning hours for the care of general surgical cases—two rooms for the men's surgical clinic, two for the women's surgical clinic, one for the children's surgical clinic and three for the fracture clinic. The remaining space was allotted to the surgical diagnostic clinic and other specialties. Waiting space for patients of all these clinics was provided in the main waiting-room. Pharmacy, operating-room (for minor surgical operations) and laboratory (for outpatient work) were in the outpatient department; the roentgen-ray department was in the main hospital.

Treatment Hours.—Surgical clinics in the outpatient department were held daily except on Sunday, from 9 o'clock until about 12:30. Patients applying for treatment during other hours or on Sunday were cared for in the emergency ward and given a return appointment to the surgical clinics in the outpatient department.

Staff.—The chief and assistant chief of clinic were members of the attending staff of the Presbyterian Hospital under the director of surgery. Three other physicians were on duty in the four clinics studied: two were members of the teaching staff of the College of Physicians and Surgeons, and one was an intern of the Presbyterian Hospital. (Each intern spent about two months in a surgical clinic, and during the course of the study three different interns served in succession). The administration of the outpatient department was under the superintendent and the assistant superintendent of the outpatient department.

Each clinic had a pupil nurse under the direction of a supervising instructor (or her assistant) and the immediate supervision of the physician in the clinic. These nurses usually spent two weeks in each clinic.

Each clinic had an "aide" or clerk. The aide was a paid member of the clerical staff. In three of the clinics that were studied the aide was assisted by a volunteer under her direction. In one of the clinics there was no paid aide during part of the study, and the work was divided between two volunteers. Before the study was completed a paid aide was installed to replace one of the volunteers.

A member of the social service staff was on duty in the outpatient department during clinic hours. Patients were referred to her from the clinics.

---

* This scheme of organization and administration prevailed at the time the study was made, from January to June, 1925. Several changes have since been made.

A cashier, an information-admitting clerk, a chief file clerk and two assistants, two stenographers, a statistician, a laboratory technician and three porters composed the rest of the general outpatient staff which served all clinics.

Reception of New Patients.—New patients were directed by a doorman to a waiting bench, where they were given blanks to fill out which contained identifying items—name, address, age, sex, etc. The information-admitting clerk assisted them in filling out the blanks, if necessary. She questioned them as to income and obligations and decided whether they were financially eligible for clinic care, and whether a reduction of fee was indicated. An admitting physician (one of the surgeons serving for a designated part of the session in addition to his other duties) assigned each patient to the proper clinic. The patient then passed to the record window where his clinic card (with spaces for days and hours for appointment on the back) and history sheets were made out. His name was cleared with an alphabetical file to verify his statement that he had not been a patient in the institution before. An alphabetical card with identification data was made out for every new patient. From the record window the patient passed to the cashier's window to pay his fee, and was then directed to a waiting bench in front of the clinic to which he had been assigned.

History.—History-taking procedure differed during the time of the study. In the men's, women's and children's general surgical clinics it was customary for the aide to come out to the waiting benches and ask the new patient his chief complaint, its duration, cause, previous treatment and past history if she thought it relevant. This history she wrote directly on the medical record. In the fracture clinic the history was usually taken by the physician or by a medical student under supervision.

Method of Conducting the Clinic.—In the general clinics the aide called the patients for treatment in groups of ten or more, according to the size of the rooms in the clinic, and seated them in chairs in a row. The order of appointment of the old patients, or the order of arrival of the new patients was observed as far as possible by the aide in calling the patients, but shortage of screens, delay in arrival of medical records or roentgen-ray reports, necessarily affected the order in which patients were called. The aide arranged the medical records of the patients on her desk in the order in which the patients sat. When all the chairs were filled, the physician went from patient to patient asking supplementary questions on the history and examining the part affected. He dictated to the aide his notes of observation, treatment prescribed and the return date, and she wrote the notes in longhand on the record. The nurse followed the physician, doing the dressings as ordered, and consulting the chart, if necessary. The aide recorded the day and hour of

the return appointment in a book and on the patient's card, made out laboratory slips or roentgen-ray requisitions, and arranged for the patient's transfer or reference to other departments or institutions. When the physician had dictated the data concerning all the patients, he returned to do certain dressings or to assist the nurse. By the time the patient was ready to leave, the aide had made any necessary appointments for him, and gave him his appointment card and any directions needed. When two rooms in the clinic were used, the first one was usually cleared and ready for a new group of patients while the last dressings were being done in the second room. The process of filling the rooms and treating the patients in groups was then repeated.

In the fracture clinic the patients were called in, one or two at a time, and seated at the physician's desk. He read the records, talked with each patient, and made the examination at the time, or later if the patient had to go behind a screen. Practice as to dictation differed among the physicians in the fracture clinic, but in general they made their own notes, leaving the aide free to make appointments, to arrange for necessary roentgen-ray work and to take care of cases in which the patients were referred to different departments or institutions.

A system of appointments was in operation in all departments.

Records.—The "unit" form of medical record was in use. All treatment of patients was recorded chronologically on one record, and all reports of tests, all correspondence, roentgen-ray reports, etc., appeared in the record. This applied to all departments of the hospital, including the ward and social service department. On each visit, the physician's notes gave condition, recommendations and disposition—including the date that the patient was expected to return.

In the fracture clinic a diagnostic and follow-up file was kept of patients under care, and it was possible to learn the status of each case by consulting the file. As patients with fracture usually remain under supervision for many months, sometimes several years, such a file is necessary. It was taken care of by the aide. In the general surgical clinics the appointment book was the only index of the patients.

All records of patients were brought to the clinic by messenger. The aide requisitioned in advance records of patients expected by appointments. Records of new patients or of old patients returning without appointment were sent to the clinic by messenger, as the cashier noted the chart numbers of patients who had no appointment on their cards and transmitted the information to the file clerk.

Use of Social Service.—Patients for whom the physicians ordered apparatus or who were referred for admission to the ward were conducted to the social worker's desk by the aide for inquiry as to financial resources and for assistance in making the necessary arrangements. Apparatus was ordered and the patient's payment received by the social

worker. Other patients were referred to the social worker for inquiry or assistance at the discretion of the physician or the superintendent.

Teaching.—Student nurses received practical instruction at all times from the physicians in charge of the clinics. Interns were under the supervision of a regularly appointed surgeon. Teaching of students from the College of Physicians and Surgeons took place on four days a week. The physician in charge of the men's surgical clinic and the chief of clinic or assistant chief of clinic, one of whom was usually on duty in the fracture clinic, gave this instruction. The dean of the College of Physicians and Surgeons was present one morning a week in the fracture clinic during the academic year as instructor and another morning as consultant.

General.—There were variations in the clinics at the time of this study. The women's surgical clinic was handled by three different interns during the five months of the study. The children's surgical clinic—not a large one—had no full-time physician, but was visited at intervals by physicians from other clinics. The fracture clinic was in the hands of the chief of clinic, or the assistant chief of clinic and one other physician. The men's surgical clinic was in various hands during the time of the study as the physician usually in charge was absent part of the time from illness. In the men's surgical clinic one physician taught medical students as well as examining and treating patients, often simultaneously, using the students to take the histories and assist with the dressings. He was on duty certain hours for admitting new patients, assisted in the children's surgical clinic, and was on duty in the operating room.

METHOD OF SUMMARY*

CARD NO. 1

Name Number	A	B	C Difficulties to Patient	D Difficulties to Clinic
Problem		Orders		
Diagnosis		Clinic 1 2 3 4 etc. No. carried out	I Caused by condition — Overcome? Agent?	
Classification	Disability?		II Caused by treatment	
How referred			III Caused by medical management	V Difficulties to medical management
Collateral medical problem Previous treatment?	Handled by clinic?	Patient 1 2 3 4 etc.		
Collateral social problem				
Previous treatment?	Handled by clinic?		IV Caused by administrative management	VI Difficulties to administrative management
Physicians Disposition Patient's opinion of progress				

* A summary of each case was made on two 5 by 8 cards arranged as illustrated. All items were written in full except the difficulties, which were coded.

METHOD OF SUMMARY *
CARD No. 2

Name Number		Disposition				
Age	Number of broken appointments	Number of visits	Rate	Cost at rate	Rate to patient	Actual cost to patient
Sex	Number days under treatment	Special tests				
Civil status		Apparatus				
Usual occupation Usual wage Usual family income Number persons in family		Transportation Miscellaneous Number days totally disabled		Total cost at rate Cost at regular rate of pay		Total actual cost Total actual cost
Other resources		Time to and from clinic Time in clinic Total time		Cost of time at regular rate		Total actual cost

SPECIAL STUDY OF DIFFICULTIES ENCOUNTERD

The difficulties encountered in connection with the giving of treatment were grouped under two main headings: those encountered by the patient, and those encountered by the clinic.

The difficulties experienced by the patient were those caused by:

(1) The condition itself (such as pain, inability to engage in usual occupation, etc.)

(2) The treatment for the condition (such as absence from home on the part of a mother with young children whose care must be arranged for. Expense.)

(3) Failures in medical management (such as giving inadequate instructions). With this group were included certain failures in recording and study, which constituted potential if not actual difficulties. Examples of this group would be failure to approve apparatus secured by the patient, or evasion of the responsibility of deciding whether patients who did not keep their appointments should be followed up.

(4) Failures in administrative management (such as inadequacy in referring patients from one department to another, breaks in carrying out the appointment system, etc.)

The difficulties experienced by the clinic were, in general:

(1) Those which interfered with study and treatment (such as failures in cooperation on the part of the patient).

(2) Those which disturbed the administrative machinery (such as incorrect addresses or patient's failure to come in time for his appointment).

TABLE 6.—*Difficulties to Patient, Instances and Comments*

	Patients Affected	Comments
Caused by Condition		
Physical		
Pain or discomfort	143	
Sleeplessness	35	
Temperature	7	
Swelling	20	
Bleeding	3	
Weakness	1	
Limitation of function	15	
Interference with personal care	5	
Mental		
Anxiety about		
Condition	26	
Possible loss of job	9	
Possible loss of pay	8	
Fear of treatment	12	
Social-Economic		
Interference with usual occupation		
Inability to work at all	65	
Inability to work full time	9	
Inability to work with usual efficiency	20	
Necessity of changing occupation	3	
Loss of job	4	
Loss of pay	17	(data incomplete)
Caused by Treatment in Clinic		
Physical (pain, discomfort, etc. not noted)		
Trip to clinic causes pain	4	
Waiting in clinic nauseates patient	1	
Treatment during clinic hours means loss of sleep to patient, who works at night	2	
Mental		
Anxiety about		
Children at home	3	
Possible loss of job because of absence for treatment	2	
Social-Economic		
Interference with usual occupation		
Patient gives up job because of difficulty in arranging absence for treatment	1	
Danger of loss of job	1	
Time lost for treatment reduces output	11	
Reduction of income for time spent in clinic	5	(data incomplete)
Bandage interferes with efficiency	1	
Children missing school for treatment	29	
Children miss more time from school than necessary	4	
Inconvenience caused others		
Employer has to do extra work	4	
Fellow workmen have to do extra work	3	
Relatives inconvenienced by having to care for children, assist with care of home, accompany patient etc.	20	
Friends inconvenienced	6	
Caused by Medical Management *		
Study and treatment		
1. Admission to wrong clinic		
Skin for surgical clinic	1	
Fracture for oral surgery	1	
Surgical for diagnostic	1	
2. History		
Emergency ward history inaccurate	1	Overcome by worker
Physician does not read history recorded on chart	11	2 overcome by worker
Last note not read by new physician	1	
Incomplete, second injury not discovered	4	1 overcome by clinic, 2 overcome by worker
3. Examination		
Incomplete, second injury not observed	6	3 overcome by worker
4. Reports		
Laboratory reports not read	4	1 overcome by clinic, 2 overcome by worker
No report requested from another institution which had previously treated same condition	2	
5. Instruction		
Patient does not understand		
Home treatment		
Soaks	20	1 overcome by clinic, 11 overcome by worker
Medication (internal)	8	1 overcome by clinic, 5 overcome by worker
Medication (external)	5	3 overcome by worker
Icebags	2	1 overcome by worker
Hot applications	3	1 overcome by worker
Use of elastic stocking	1	
Use of rubber finger	1	Overcome by worker
Sling	1	
Elevation	1	Overcome by worker
Rest	6	3 overcome by worker
Exercises	3	1 overcome by clinic, 1 overcome by worker

TABLE 6.—*Difficulties to Patient, Instances and Comments—Continued*

	Patients Affected	Comments
Continuance of usual occupation		
No advice	25	2 overcome by clinic, 1 overcome by worker
Conflicting advice	4	1 overcome by worker
Significance of condition	13	9 overcome by worker
Importance of need of treatment	3	
Subordinates not fully instructed		
Dressings	14	3 overcome by clinic, 4 overcome by worker
Apparatus to be ordered	2	
Follow-up		
From clinic	24	
From emergency ward	4	
From operating room	2	
Refer to other department	11	1 overcome by clinic, 4 overcome by worker
Tetanus antitoxin	1	
6. Supervision of subordinates		
Student		
Does not carry out orders	2	
Puts on poor bandage	2	1 overcome by clinic
Nurse		
Does not carry out orders	7	3 overcome by clinic, 1 overcome by worker
Repeats dressing without orders	5	
Applies wrong dressing	2	
Puts splint on upside down	1	Overcome by clinic
Patient operated on without permit	1	
Aide		
Renews prescription without consulting physician	3	
Advises frequency of soaks	1	
Advises discontinuance of soaks	1	Overcome by worker
Drops case without consulting physician ††	9	1 overcome by worker
Writes letter about treatment	1	
Decides frequency of baking and massage	2	
Delays in carrying out order	1	Overcome by worker
Decides on return date	1	
Advises patient to postpone dental care	1	
Signs prescription	6	
7. Observation of results of treatment		
No return date given after prescription of		
Elastic stockings	3	
Elastic bandage	2	
Medication	1	
Radiotherapy	1	
Baking and massage	3	
8. Recording		
Diagnosis		
No diagnosis written	1	
Unclassified on discharge	6	
Not rectified by additional diagnosis	4	
None on collateral condition treated in clinic	7	1 overcome by worker
Examination made not recorded	5	2 overcome by clinic, 1 overcome by worker
Treatment given or ordered		
In clinic		
Dressings	17	1 overcome by worker
Baking and massage	8	2 overcome by worker
Roentgen ray	2	
Medication	10	1 overcome by clinic, 1 overcome by worker
Type of elastic stocking	1	
Tetanus antitoxin	1	Overcome by worker
Anesthetic	1	
Refer to other departments	1	
Inspection of apparatus	4	
Other institutions		
No letter with patient referred to another institution	1	
No report to institution referring case	2	
Advice to patient		
Collateral condition	1	
Rest	3	
No work	14	
Soaks	10	
Drink water	1	
Icebag	1	
Hot applications	1	
Medication	3	
Dressings	1	
Elevation	1	
Exercises	2	
9. Miscellaneous		
Patient desiring to consult physician given no opportunity	10	1 overcome by clinic, 2 overcome by worker
Patient treated without chart	3	
Physicians discuss case in presence of patient and arouse doubt	1	

TABLE 6.—*Difficulties to Patient, Instances and Comments—Continued*

	Patients Affected	Comments
Dressings		
Come off at home	16	
Cause pain	6	
Patient dissatisfied		
Complains house officer is rough	1	
Verbal complaint to physician about collateral condition is ignored	2	
Feels examination inadequate	1	
Not satisfied with elastic stocking	2	
Caused by Administrative Management *		
1. Instruction of patient inadequate		
Refer to other clinic	1	Overcome by worker
Need of bringing adult	1	
Release	1	Overcome by worker
Reason for postponement of operation	2	
Cost and hours of baking and massage	6	Overcome by worker
Appointment card	9	1 overcome by clinic, 6 overcome by worker
2. Directing patients		
To clinic—Patient admitted to clinic without going to cashier	5	
From clinic		
Patient not directed to emergency ward	2	1 overcome by worker
Patient not directed to operating room	2	2 overcome by worker
Patient not directed to pharmacy	2	1 overcome by worker
Patient not directed to baking and massage	1	Overcome by worker
Patient not directed to appointment desk	2	Overcome by worker
Patient not directed to dental clinic	1	Overcome by worker
Patient not directed to fracture clinic	1	Overcome by worker
3. Financial management		
Admission		
Patient admitted who, in opinion of study worker, could pay private rates	6	1 overcome by worker
Patient treated in emergency ward after refused care in outpatient department	1	Overcome by worker
Compensation case not discovered	2	Overcome by worker
Assessment		
Fees collected from patient who, in opinion of study worker, could not afford to pay	13	6 overcome by worker
Patient charged for postponed operation	2	1 overcome by worker
Cashier collects fee, although card is marked "free"	1	Overcome by worker
Card not marked "free" after arrangement for free care	2	1 overcome by worker
4. Carrying out of appointment system		
Patient not called in order	10	
Patient not consulted; hour of appointment inconvenient	14	4 overcome by clinic, 7 overcome by worker
Patient allowed to leave without appointment	2	2 overcome by worker
Appointment given without consideration of need of roentgen-ray report	4	
Long delay before patient can get appointment for medical clinic	3	1 overcome by worker
Long waiting time in clinic †	162	
Broken appointment in other departments not reported to clinic	3	1 overcome by worker
5. Identification		
Change of address not noted	3	1 overcome by clinic, 1 overcome by worker
Wrong address copied on chart	1	1 overcome by clinic
Age wrong on chart	1	
Patient has two charts	2	
6. Recording		
Dictated notes incorrectly transcribed	8	2 overcome by worker
Anesthesia permit not attached to chart	1	
No carbon of letter written about patient on chart	2	
Incomplete note by social worker	4	
Letter from or about patient not noted on chart	5	
Diagnosis not copied on front page	4	
Appointments		
Inaccuracies in recording	31	6 overcome by worker
Follow-up appointments not cancelled when patient comes in	3	
No witness on release slip	1	
7. Miscellaneous		
School children not given excuses	2	1 overcome by worker
Postponement of operation until next day because of delay in referring	2	
Conflicting instructions	1	Overcome by worker
Consideration of patient		
Exposed patient complains of cold, no assistance	1	
No effort by aide to get information requested by patient	2	Overcome by worker

* Unless noted, not overcome.
† See separate study of delay.
†† Only noted here if difficulty was caused.

TABLE 7.—*Difficulties to Clinic, Instances and Comments* *

Difficulties to Medical Management Study and treatment	Patients Affected	Comments
1. Personality		
Language difficulty	14	
Low intelligence	2	
Inaccuracy	2	
Exaggeration	1	
Timidity	5	
Stoicism	1	
Deafness	1	
Drunkenness	1	
Discouragement	1	
Reticence	6	
Over-confidence	1	
Lack of confidence in physician	2	
2. Environment		
No responsible person accompanying	4	
Poor home care		
Neglected child	4	
Hyperactive child, uncontrolled	1	
Disturbed home	1	
Parents unwilling child should have care	1	
Lack of facilities to carry out advice	1	
Unrelieved social situation	1	
3. Other sources of study		
Patient referred from another hospital without letter	1	
No report from institution to which patient was referred	1	
4. Cooperation in carrying out treatment		
Refusal to accept treatment in clinic		
Head shaving	1	
Tetanus antitoxin	1	
Operation	2	
Failure to carry out other orders		
Rest	3	
No work	4	
Refer to another department	8	
Refer to another institution	2	unknown
Apparatus	1	
Bed	1	Overcome by worker
Force fluids	1	Overcome by worker
Icebags	2	
Soaks	5	
Exercises	1	
Poultice	6	1 overcome by worker
Elevation	1	
Patient removes dressing at home	6	
Attendance		
Broken appointments	149	
No response to follow-up	40	
Treatment not completed	62	
5. Condition (incomplete)		
Delay in coming for treatment	4	
Reaction after tetanus	1	
Patient too sick to come to clinic	1	
Bleeding after operation	1	
Recurrence of ulcer three days after discharge	1	
Difficulties to Administrative Management		
1. Identification		
Wrong address	4	
Patient gives wrong name	1	
2. Appointment system †		
Patient late	12	
Patient comes without appointment	7	

* Unless noted, not overcome.
† Only noted here if difficulty was caused.

Such difficulties as the patient actually encountered in the clinic or as could be learned by interviewing him and studying his record have been carefully recorded by the study worker. There must necessarily be a large number which occurred in the home or at work which the study worker did not learn. The difficulties caused the clinic are by no means

adequately represented, and must be simply considered as illustrative. For example, a lay worker could not determine whether delay on the patient's part in seeking treatment constituted an obstacle to the clinic. One patient came to have a bullet extracted several months after she was injured, and the surgeon explained that this delay was of advantage to the clinic in this particular case. Only a few details of instructions inadequately carried out at home could be learned by the worker in conversation with the patient. Had it been possible to visit every patient and observe the method by which he carried out the instructions received, much would have been discovered. Several visits were made by the worker, and each contributed illuminating material. The record of difficulties, therefore, is by no means exhaustive, and the apparent emphasis on difficulties encountered by the patient as the result of certain breaks in technic occurring in the clinic is due not to a critical attitude on the part of the observer, but to insufficient information as to other difficulties which could not be observed at first hand.

This rough classification is the result of an attempt to analyze material which is so elusive and complicated as almost to defy grouping. Any difficulty encountered by a patient is, in the last analysis, also a difficulty to be met by the clinic, and nearly all difficulties met by the clinic are real or potential difficulties to the patient. The artificiality of the foregoing groups is therefore obvious.

In tabulating these difficulties, attention was paid, when possible, to noting whether the difficulty was overcome, by whom it was overcome—especially whether it was righted without the assistance of the study worker. As we have said elsewhere, a certain obligation was incurred on the part of the study worker by the fact that she had taken the initial history of the case, and that the patient had learned to turn to her with some of his questions. As far as possible she endeavored to play the part of observer only, but there were instances where the righting of error or misunderstanding was necessarily stimulated by her.

The element of time involved in certain situations made it almost impossible to attempt to classify difficulties on the basis of whether they were overcome; for example, if a patient leaves the clinic three days in succession without being able to ask the physician whether he can return to work, and finally gets the information on the fourth visit, can one call that difficulty *overcome,* although the patient finally receives the necessary instructions? No attempt is therefore made to state whether difficulties are overcome or not unless the conclusions are clear cut.

The difficulties are in the main tabulated on the basis of instances, not patients. The same patient might be responsible for three out of a hundred instances of failure to cooperate in carrying out orders. On the other hand, such difficulties as failure to understand the English

language or anxiety over financial matters would be listed only once per patient. An attempt is made to indicate where the difficulties are listed by patients and not by instances. It is important to note also that the difficulties ascribed to inadequate instruction of patients are listed without regard to whether they concern the initial instruction or the final order to discontinue. From the point of view of the patient, it is just as important to know whether he can return to work as it is to know whether he must stay home from work. It is the impression of the study worker that of the two instructions, the former is the one more often neglected. Effort is made to get the patient to understand that he must soak his finger, but he must frequently take the initiative in finding out when he can discontinue the treatment.

THIRTY-THIRD REPORT OF PROGRESS IN ORTHOPEDIC SURGERY*

PHILIP D. WILSON, M.D.; LLOYD T. BROWN, M.D.; HARRY C. LOW, M.D.; M. N. SMITH-PETERSEN, M.D.; MURRAY S. DANFORTH, M.D.; RALPH K. GHORMLEY, M.D.

BOSTON

HERMAN C. BUCHOLZ, M.D.

HALLE, GERMANY

AND

ARTHUR VAN DESSEL

ANTWERP, BELGIUM

CONGENITAL DEFORMITIES

Congenital Dislocation of the Knee Joint.—Baldwin [1] reports a case of congenital anterior dislocation of the tibia on the femur. The knee was in a position of extreme hyperextension, and no flexion was possible. The condition was recognized at birth, and the deformity corrected ten days later. Under anesthesia, the dislocation was reduced with little difficulty and the leg splinted. Fixation was discontinued at the end of six months. Now, at the end of eight and one-half years, there is normal function of the knee, and the patella is fully developed. The author notes from the literature that absence of the patella has been a frequent accompaniment of this condition. He believes that the development of a sesamoid bone depends on normal function of its tendon and that in his case the presence of the patella is a result of the early restoration of function.

TUBERCULOSIS

Heliotherapy in Pott's Disease in Children.—Ghormley [2] reports the experience of the New England Peabody Home in the treatment of tuberculosis of the spine in children, based on the study of sixty-three patients, for the most part under 10 years of age. While the diagnosis was verified in only a few of the cases by actual demonstration of the bacillus, he believes that the margin of error in Pott's disease in children is almost nil. He considers that three factors are of special importance in following progress: (1) improvement in the spinal deformity, as

---

* This Report of Progress is based on a review of 145 articles selected from 470 titles dealing with orthopedic surgery appearing in medical literature between Nov. 7, 1926, and March 12, 1927. Only those papers which seem to represent progress have been selected for note and comment.

1. Baldwin, C. H.: J. Bone & Joint Surg. **8**:822 (Oct.) 1926.

2. Ghormley, R. K.: Heliotherapy in Relation to Treatment of Tuberculosis of the Spine in Children, J. A. M. A. **88**:289 (Jan. 28) 1927.

shown by accurate measurement; (2) gradual upward curve in the monthly weight chart, and (3) evidence of healing by roentgenologic examination at regular intervals of four months. For immobilization and correction of the deformity, a split plaster jacket applied in hyperextension on the Goldthwait frame has been employed. Deformity was most difficult to reduce in the cervical region, and the results were increasingly good the lower down the lesion was in the spine. Heliotherapy was carried on under the difficult conditions of a yearly average percentage of possible sunshine of 57 per cent. During the winter months, this fell to 48 per cent. The weight charts showed a general tendency to drop during the winter months, and in the summer months a marked rise occurred. This applied to all groups, whether recumbent or ambulatory, and obviously was related to the climatic conditions. Ultraviolet rays are now used as an adjunct to heliotherapy. Ghormley reports the examination of a healed spine removed at autopsy, in which on careful study not the slightest trace of a focus of tuberculosis could be found. This suggests that complete healing with eradication of the disease may occur. He concludes that though the advantages of heliotherapy are well known, the calcification in the lesion and the abscesses is an important change, and the altered reaction of the tissues through allergy may be better sustained under heliotherapy, and thus healing may be favored.

[ED. NOTE.—The work of the New England Peabody Home shows that by heliotherapy, combined with recumbent and fixative treatment, Pott's disease in children in many instances may be arrested and perhaps permanently cured.]

Posterior Mediastinal Abscess in Tuberculosis of the Dorsal Spine.—Steindler [3] has analyzed a series of 280 cases of tuberculosis of the spine and has found posterior mediastinal abscess present in twenty-three, or 8 per cent, of the entire group. This was 15 per cent of all the cases of Pott's disease of the dorsal spine. Paraplegia from extension of the abscess or of tuberculous granulation tissue into the spinal canal with pressure on the cord occurred in fourteen of the twenty-three cases. From the evidence gained at necropsy, when the communication between the mediastinal abscess and the spinal canal could be demonstrated. Steindler concludes that evacuation of the abscess by costotransversectomy would appear a thoroughly rational procedure and one likely to bring about rapid recovery from the paraplegia.

PYOGENIC INFECTION OF THE BONES AND JOINTS

Pathogenesis of Lesions of Acute Osteomyelitis.—Wilensky [4] believes that the primary lesion of acute osteomyelitis is a thrombo-

3. Steindler, A.: Illinois M. J. **50**:201 (Sept.) 1926.
4. Wilensky, A. O.: Ann. Surg. **84**:651 (Nov.) 1926.

embolic process and that the character of the lesion of the bone is determined by the point of lodgment in the nutrient arterial system. He has reviewed a number of cases at a late period in their course and has classified the lesions on an anatomic basis as follows: 1. Subperiosteal abscess. 2. Main stem of nutrient artery. 3. Primary division of nutrient artery. 4. Secondary division of nutrient artery. 5. Terminal vessel in bone. 6. Multiple processes. 7. Periosteal and osteal multiple lesions.

He points out that the disease may spread by secondary infections or as a result of unwise surgical procedures. The former he believes due to progressive and regressive thromboses.

Purulent Arthritis in Children.—Macchi,[5] writing on acute suppurative arthritis in infants, states that the organism most frequently present is the pneumococcus. It is almost always a secondary infection, and the primary focus in 91 per cent of the cases is an infection of the middle ear. The most frequent localization of arthritis due to pneumococcus is in the hip joint, with the knee and shoulder next. Why the hip joint is most frequently involved cannot be explained. The author suggests that it is due to the lack of resistance of the long bones, especially those of the femur, which are in the process of rapid development. Pneumococcic arthritis is almost always monarticular. The date of appearance of the lesion of the joint in relation to the original focus is variable. In the adult, it is likely to occur during the acute attack, but in children it may appear as late as ten or twelve weeks after subsidence of the attack. Gonococcic arthritis in infants is usually secondary to vulvovaginitis or an ophthalmia of the new-born. It is usually multiple, in contradistinction to its monarticular occurrence in adults. Infections of the throat, stomatitis, solution of continuity of the skin, and infections of the umbilicus are the usual points of origin for streptococcic arthritis. While in adults arthritis often occurs without lesions of the bone, it is rare in children, except in gonococcic arthritis, which ordinarily does not cause alterations in the bone. The author considers vaccine therapy valuable, but says that the vaccines should be autogenous, prepared by the method of Wright from pus removed from the joint.

SYPHILIS

Synovial Fluid of Patients with Arthritis and Syphilis.—Chesney, Kemp, and Baetjer[6] have made a study of ten cases showing clinical or serologic evidence of syphilis in which an active arthritis was present. The investigation included study of the synovial fluid with reference to

5. Macchi, A.: Pediatria **34**:1243 (Nov. 15) 1926.

6. Chesney, A. M.; Kemp, J. E., and Baetjer, F. H.: J. Clin. Investigation **3**:131 (Oct.) 1926.

the presence of any abnormalities or of treponemes or other organisms, as determined by inoculation in rabbits and guinea-pigs and by culture, observation of the response to antisyphilitic treatment, and roentgenologic examination. The cases represented various stages in the course of the infection, including two patients with tabes dorsalis and Charcot joints. From its response to treatment, the arthritis was regarded as of syphilitic origin in five, or 50 per cent, of the cases. From the synovial fluid of three of these five patients, strains of *Spirochaeta pallida,* virulent for rabbits, were obtained by inoculation of animals of that species. In four of these five, the synovial fluid showed a relatively high percentage of lymphocytes and mononuclear cells combined. No roentgenologic observations significant of syphilis were encountered in these patients.

[ED. NOTE.—The authors have succeeded in demonstrating beyond doubt that arthritis may be a manifestation of syphilis. While it is probable that the proportion of cases due to this cause is small, at the same time this possibility will have to be excluded in the investigation of any case of arthritis.]

ARTHRITIS

Isolation of a Bacterium in Rheumatic Fever.—Small [7] has isolated a bacterium from patients with rheumatic fever which he calls *Streptococcus cardio-arthritidis.* By animal inoculation he has prepared an antiserum which he has used in nine cases of the disease. Two of the patients who later proved not to have rheumatic fever were not benefitted; the remainder showed prompt improvement following the injection of the serum in sufficient dosage. Small admits that there may be some question of the mechanism by which improvement was obtained, owing to the possibility of nonspecific foreign protein reaction entering into it. Sufficient time has not yet elapsed to permit a definite answer, but experiments to determine this are stated to be in progress.

[ED. NOTE.—Any claim for the discovery of the specific organism of rheumatic fever must be accepted with great reserve, especially when the clinical observations on which such a claim is based cover a period of only a little more than a month. Since Poynton's original contribution on this subject, the literature has contained many reports of the discovery of a causal organism and the preparation of specific vaccines and serums, all of which failed of confirmation later on. Final judgment cannot be rendered until after prolonged observation of any method of treatment, and this is doubly true in a chronic and recurring disease such as rheumatic fever.]

---

7. Small, J. C.: Am. J. M. Sc. **173**:101 (Jan.) 1927.

Influence of Focal Infection on the Pathology of Arthritis.—Pemberton, Cajori and Crouter [8] report experiments tending to show that the lowered sugar tolerance which they have so frequently observed in chronic arthritis can sometimes be corrected and a normal condition established by the use of vasodilator drugs. They consider this additional evidence that at least part of the pathologic change in chronic arthritis is due to interference with the blood supply in the smaller vessels. They point out that the observations on the blood sugar are not to be interpreted only in terms of specific carbohydrate metabolism. Glucose has been selected for study merely as the most available and easily estimated of all of the components of the blood, and is simply an expression of an alteration possibly affecting many other substances. In the light of the authors' investigations, the failure to remove glucose from the blood is probably to be referred to a failure of the blood to reach certain tissues, especially the muscles, in sufficient quantity, where under normal conditions glucose is rapidly taken up. It would therefore appear that at least occasionally the muscles of arthritic patients receive less blood as a whole than they normally should, and that therefore their physiologic function must be modified and at times much deranged. This, therefore, affords some explanation of the frequency of muscular disability in the rheumatoid syndrome and the value of exercise and massage in stimulating the flow of blood. These several observations, according to the authors, can be explained only on the assumption that arthritis is accompanied by a disturbance of peripheral blood flow, probably in the nature of vasoconstriction. This phenomenon is apparently an important result of focal infection and constitutes at least part of the pathologic process of arthritis.

Protein Arthritis.—Magnuson [9] calls attention to a type of chronic arthritis which is characterized by a stiffness in the joints which comes on after short or long periods of rest and which is relieved by exercise. The cases are not confined to any one type of individual. From the study of a group of 100 such cases, the author is persuaded that the pain and irritation are due to faulty protein metabolism. The blood uric acid was increased in 56 per cent, the blood urea in 34 per cent, and the nonprotein nitrogen in 57.5 per cent. The large majority of such patients showed improvement on a low protein diet and on increasing the elimination.

[Ed. Note.—We believe that there is a considerable gap between the conclusions that the author draws and the observations on which they

8. Pemberton, Ralph; Cajori, F. A., and Crouter, C. Y.: Influence of Focal Infection and Pathology of Arthritis, J. A. M. A. **87**:2148 (Dec. 25) 1926.

9. Magnuson, P. B.: J. Bone & Joint Surg. **8**:839 (Oct.) 1926.

are based. He not only reduced the protein intake, but increased the elimination. Many clinicians hold strongly to the view that faulty intestinal elimination plays a considerable part in the causation of chronic arthritis. May not the improvement which was noted be ascribed as much to the correction of this factor as to the altered dietary regimen? The subject of dietetics in arthritis has been a controversial one for years and one must maintain a critical attitude if the mistakes of the past are to be avoided.]

The Orthopedic Principles in the Treatment of Chronic Arthritis.—Swaim [10] discusses proliferative and degenerative arthritis, the former having two distinct types, the infectious and atrophic. The treatment in these cases should be the restoration, first, of normal function and resistance, and second, of movement of the joints. Chronic fatigue is one of the chief factors of all arthritis, and Swaim believes that it is due to disturbances of normal function of the thorax and abdomen. The disappearance of this symptom depends on the restoration of correct body mechanics. This is accomplished by special exercises in bed to increase the capacity of the chest and to relieve abdominal congestion. resistance, and, second, of movement of the joints. Chronic fatigue is Exercises are given together with abdominal massage. Thyroid extract is often used with benefit when the metabolism is low. In atrophic arthritis, the vapor bath of Wilde is given, with improvement in the metabolism. The author points out that a low carbohydrate diet is important if the sugar tolerance is low, that atrophic patients need an abundance of mineral salts, and usually cod liver oil. Experiments with the quartz lamp have been tried. During the acute stage, protection and rest of the joints are essential, and deformity must be prevented. After the acute stage, restoration of motion of the joints by active exercises and occupational therapy must be carried out. In the hypertrophic cases, relief of strain and protection against future strain constitute the orthopedic problem.

NUTRITIONAL DISEASES OF BONE

Intramuscular Injection of Cod Liver Oil in Rickets.—By the use of intramuscular injections of an ether solution of a concentrate of cod liver oil, Wilkins and Kramer [11] were able to demonstrate the same changes in the concentration of calcium and inorganic phosphorus in the blood serum in cases of infantile rickets as have been found after the oral administration of cod liver oil. From this, they conclude that "whereas cod liver oil increases the absorption of phosphorus and calcium from

10. Swaim, L. T.: J. Bone & Joint Surg. **8**:845 (Oct.) 1926.

11. Wilkins, L., and Kramer, B.: Bull. Johns Hopkins Hosp. **40**:52 (Jan.) 1927.

the intestine, the fact that it is effective when administered intramuscularly indicates that this is not a purely local action upon the intestinal mucosa, but is a general one and exerted through the circulation."

Effect on Human Milk of Irradiation of the Mother.—Hess, Weinstock and Sherman [12] have made a study of the effect of irradiation of the mother on the development of antirachitic properties in her milk. When the milk was given to rachitic rats, a striking difference was evident in the results obtained from milk that had been obtained previous to or subsequent to irradiation. Whereas no healing followed the first, after the latter, marked calcification of the epiphyses occurred in every instance. They conclude that ultraviolet irradiation of nursing women brings about a marked increase in the antirachitic potency of their milk. This effect is due to an augmentation in the antirachitic (nonsaponifiable) factor. The authors suggest that such irradiation be employed in order to protect infants from rickets and nursing women from excessive drain of calcium and phosphorus.

DEVELOPMENTAL DISTURBANCES OF BONE

Development of the Patella.—Shands [13] has studied the development of the patella in 100 children between the ages of 2½ and 6 years. The earliest time of appearance of the patella was 2½ years. In thirty-two cases of the group, no ossification center was present when first observed. The following abnormalities of development were noted: pointed superior borders, five cases; pointed inferior borders, three cases; double centers of ossification, two cases; roughened or depressed surfaces, six cases. Delayed ossification of the patella was present in four patients more than 4½ years of age. This was due to the following: congenital syphilitis, two cases; rickets and pulmonary tuberculosis, one case, and malnutrition, one case.

Overgrowth of Long Bones of Legs.—Harbin [14] reports three cases of overgrowth of the tibia and fibula. The ages of the patients varied between 12 and 14 years. The overgrowth apparently resulted from entirely different etiologic factors. In the first case, it was due to stimulation of the cartilage cells of the epiphyseal plate from adjacent osteomyelitis without invasion of the epiphysis. The second patient had a history suggesting congenital syphilis without manifestations other

12. Hess, A. G.; Weinstock, Mildred; and Sherman, Elizabeth: Antirachitic Properties Developed in Human Milk by Irradiating Mother, J. A. M. A. **88**:24 (Jan. 1) 1927.

13. Shands, A. R., Jr.: J. Bone & Joint Surg. **8**:824 (Oct.) 1926.

14. Harbin, M.: Overgrowth of Long Bones of Lower Extremity, Arch. Surg. **14**:142 (Jan.) 1927.

than a positive blood Wassermann reaction. The third case showed a generalized enlargement of the lower part of the left leg, with nerves and enlarged veins, apparently of congenital origin.

Vertebral Epiphysitis.—Buchman [15] reports two cases previously diagnosed as vertebral epiphysitis in which spinal deformity later developed. He regards these symptoms as proof that so-called vertebral epiphysitis is the cause and not the result of spinal deformity.

Femoral Osteochondritis and Epiphyseal Separation.—Balensweig [16] reports eighteen cases of femoral osteochondritis. All showed varying degrees of epiphyseal separation. Ten patients were treated by the manipulative method of Whitman, followed by plaster fixation; three, by the application of short plaster spicas with weight-bearing and two, by open operation; three were untreated. Of the manipulated cases, an excellent result was obtained in one, satisfactory in one, fair results in five, and nonunion in one. Of the two patients treated by open operation, one result was poor and the other satisfactory. The author inclines to the theory that the chief etiologic factor is a low grade infection and that traumatism and endocrine dysfunction are contributory causes. These etiologic factors bring about coxa plana in the first decade; femoral osteochondritis complicated by varying degrees of slipping of the capital epiphysis in the second decade, and osteo-arthritis in the third decade and later.

[ED. NOTE.—There appears to be little clinical or experimental support for the use of the term osteochondritis in designating the condition known as coxa vara of adolescence. We believe that the term epiphysolysis more accurately describes the process than any other.]

Bone Sarcoma.—Summing up the present knowledge, Bloodgood [17] states that in periosteal and diffuse lesions below the upper third of the femur, amputation offers more than radiation. In the arm, resection offers more than radiation. If the lesion is in the upper third of the femur or is of such an extent as to rule out resection, radiation should be the therapeutic method of choice. The author advises exploration of the tumor for diagnostic purposes, with immediate microscopic examination of frozen sections and a report. If this is impossible, tissue should be removed with the cautery and sent to the pathologist. The author considers as the weakest point in providing proper treatment the inability to make a correct diagnosis from frozen sections so that further operation, if indicated, may be done at once.

---

15. Buchman, Joseph: Relationship Between Vertebral Epiphysitis and Spinal Deformity, Arch. Surg. **13**:568 (Oct.) 1926.

16. Balensweig, I.: Surg. Gynec. Obst. **43**:604 (Nov.) 1926.

17. Bloodgood, J. C.: J. Bone & Joint Surg. **8**:727 (Oct.) 1926.

Giant Cell Tumor.—Goforth [18] reports six cases of giant cell tumor of the bone. From a study of these cases, he concludes that the giant cell tumor is a true neoplasm, essentially benign. Under the stimulus of inadequate or improper treatment, it may recur locally. Such recurrences, as a rule, are more virulent than the primary growth, both clinically and on microscopic examination. On rare occasions, the tumor may undergo malignant transformation and may form metastases.

BACK STRAIN

Spondylolisthesis.—Writing of spondylolisthesis, Asbury [19] says that it is not a common condition, but that it occurs often enough to be of practical importance in the differential diagnosis of backache. The structure, embryologic formation, and function of the lumbosacral joint are factors in the causation of the subluxation. The onset of symptoms may be gradual or sudden. If sudden, the cauda equina is more apt to be injured because a sudden onset is usually associated with severe trauma. A constant feature in the history is the relief obtained from rest. On abstaining from exertion for a few days, the dull, boring back pain and radiating sciatic pain cease, only to reappear immediately on resuming work. The telescoped shortened trunk, with the exteme lordosis of the lumbar spine, the concavity above the sacrum, and the prominent upper border of the sacrum or pseudokyphosis, are the outstanding features to be seen on examination of the patient. The inclination of the pelvis is lost, and the birth canal at both inlet and outlet is narrowed. Frequently, there are signs of a partial caudal lesion, but a complete lesion is rare because only the body of the vertebra is dislocated in most cases. Operative stabilization of the spine seems to be the only logical method of treatment in cases showing severe disability. This prevents further progress of the subluxation and causes the superincumbent weight to rest in a more normal line on the sacrum. This is particularly necessary in cases showing involvement of the cauda equina. In milder cases, external support seems sufficient to relieve symptoms.

MISCELLANEOUS

Painful Heel.—Roederer [20] reviews the various theories of the pathogenesis of talalgia. Despres thought that it was due to a contusion of the cellulo-adipose tissue of the heel, resulting from prolonged standing. Duplay considered it an inflammation of the bursa under the heel, which has been described by Lenoir. Reclus, from a roentgenologic

18. Goforth, J. L.: Giant Cell Tumor of Bone, Arch. Surg. **13**:846 (Dec.) 1926.
19. Asbury, Eslie: Spondylolisthesis, J. A. M. A. **88**:555 (Feb. 19) 1927.
20. Roederer, C.: Paris méd. **2**:70 (July 17) 1926.

study, concluded that it was caused by bony exostosis. Roederer reports some personal cases and points out that the generally accepted view at present is that the exostosis is produced by periosteal inflammation and that it is the periosteitis which accounts for the talalgia.

Talipes Cavus from Anomalies of Dura Mater.—Bréchot [21] believes that so-called idiopathic talipes cavus is primarily the result of muscular hypertonicity, with secondary contraction of the aponeurosis, tendons and ligaments. The cause is an irritation of the nerves of the cauda equina. He has explored the cauda equina in two such cases and reports finding what appeared to be a congenital thickening of the dura mater. He considers this anomaly sufficient to incite hyperirritability in the nerves. It may occur with or without associated malformations of the vertebral laminae.

Ossifying Hematoma.—Stone [22] has made a study of six cases of posttraumatic ossification in the soft parts, and concludes that the condition is an ossifying subperiosteal hematoma instead of a myositis. In each of the cases, there was a history of a hard blow followed by a swelling, which later decreased in size. Gradually, ossification developed. Operation was performed in four out of the six cases. Each tumor was found to be bone entirely covered with periosteum. Muscle was attached to the outside, but not once was it found inside the mass. This would make it appear that following the injury there was bleeding next to the bone. The periosteum was pushed up and stretched into various shapes, in which position ossification took place. Ossification was complete within two months after injury and, with one exception, operation was not performed until after this stage had been reached. Good function returned promptly and has been permanent. In two instances operation was not necessary, the condition being improved by heat and massage.

[ED. NOTE.—There has been a good deal of confusion in the differentiation of ossifying hematoma and myositis ossificans, and Stone's observations indicate that the former is the condition usually encountered. Operation is indicated only when disability still exists after the ossifying process has reached an end stage.]

Cervical Ramisection.—Leriche and Fontaine [23] report that only slight and transient disturbance followed the severing of the last cervical and the first dorsal rami communicantes in fourteen cases. Postoperative pains were noted in 14 per cent. In one case there was pain in the temporomaxillary joint and lower teeth, and in another, in the acromion. Pain in the frontal and occipital regions occurred in three instances.

21. Bréchot, A.: Paris méd. **2**:57 (July 17) 1926.
22. Stone, C. A.: Ossifying Hematoma, J. A. M. A. **87**:1885 (Dec. 4) 1926.
23. Leriche, R., and Fontaine, P.: J. de Chir., February, 1926, p. 143.

Other sensory disturbances were rare. Muscular atrophy developed in the shoulder and hand in one case after ramisection for angina pectoris associated with tactile hyperesthesia. A slight and transient hyperemia of the nasal, laryngeal and pharyngeal mucosa, entailing brief rhinitis, hoarseness, and slight dysphagia was present in all cases. The authors conclude that the pains and muscular atrophy are the direct consequences of severing the nerves, while the headaches and sensory disturbances are the indirect result from circulatory changes after the operation.

In a second communication, Leriche [24] reports his observations on the effect of section of the rami communicantes in eighteen cases. He concludes that the operation does not modify the sensations of cold, heat and pain, but that it alters the mysterious internal sense of the reality of the existence of the body. He describes one case in which a man with an extremely painful amputation stump and hallucinations of painful contracture in the fingers of the missing hand was freed of all these disturbing sensations by ramisection from the second cervical to the first dorsal. The rami communicantes appear to be the vehicles for the transmission of cenesthesia, i. e., the sense of consciousness of the functioning of the organs of the body. Cases like this one suggest a new field for treatment of painful and perverted cenesthesia.

Rowntree and Adson [25] report a case of rheumatoid polyarthritis of six years' duration which had been resistant to all treatment. Finally, bilateral lumbar sympathetic ganglionectomy and ramisectomy were performed. Prior to operation the feet were cold, mildly cyanotic and sweating. After operation the pain disappeared and the feet were pink, warm, dry and comfortable. The relief persisted until the patient was last seen, two months after operation. The patient desired to have a similar operation performed on the arm.

[Ed. Note.—The foregoing case is not interesting as an example of the way arthritis should be treated, but as an illustration of the effect, perhaps temporary, of ramisection.]

Orthopedic Problems in Leprosy.—The field that leprosy affords for orthopedic treatment has been comparatively neglected. McIlhenny [26] has established a department of physiotherapy in the National Leprosarium at Carville, Louisiana, where there are about 250 cases, and feels that the value of treatment in preventing and correcting the deformities resulting from this disease has been demonstrated. Atrophy of the

24. Leriche, R.: Lyon chir., December, 1926, p. 60.

25. Rowntree, L. G., and Adson, A. W.: Bilateral Lumbar Sympathetic Ganglionectomy and Ramisectomy, J. A. M. A. **88**:694 (March 5) 1927.

26. McIlhenny, P.; Orthopedic Problems in Leprosy, J. A. M. A. **87**:1888 (Dec. 4) 1926.

interossei muscles, claw foot and contractures of various types were benefited by massage, contrast baths and exercises. Ultraviolet and deep light therapy gave excellent results in nerve pain, indurated areas, old ulcers and bone necrosis. Diathermy proved of value but was dangerous when anesthesia existed in the part.

Heredity of Dupuytren's Contraction.—Sprogis [27] has traced Dupuytren's contraction in seventeen of fifty-three persons, representing five generations of one family. Among them were only two women. From his investigation, he concludes that there is a marked hereditary tendency for the condition, that men are much more subject to it than women, and that both parents may transmit it to their descendants. He also notes that the process involves, besides the palmar fascia, also the digital nerves, the connective tissue and the skin.

BONE, JOINT AND TENDON SURGERY

Thenar Paralysis.—Lyle [28] reviews the various operations employed for paralysis of the thumb and concludes that a procedure combining the operations of Steindler and Ney is best. By the former operation, the tendon of the flexor longus pollicis is split and a portion turned down and attached to the base of the proximal phalanx. In the latter operation, the palmaris longus muscle, when present, or in its absence the flexor carpi radialis muscle, is transplanted into the tendon of the extensor pollicis brevis. When no active tendons are available, an arthrodesis of the basal joint of the thumb is useful in restoring the opposing action of the thumb.

[ED. NOTE.—We believe that tendon transplantation is of value when the thumb is paralyzed, and endorse the recommendations of the author.]

Operative Treatment of Scoliosis.—Dickson [29] favors operative fusion of the spine in severe cases of scoliosis, and reports the results that he has obtained by this method in twenty-eight cases. The greatest number of vertebrae fused in any one case was fifteen; the least number fused was eight. The results have been nearly uniformly successful; in only one case has the operation been a failure. Of the twenty-seven patients in whom the operation was successful, none is wearing support, except those recently operated on, and all show definite improvement in deformity, which has been maintained without relapse. All are leading normal lives and are either at work or at school and none complains of the back.

---

27. Sprogis, G.: Compt. rend. Soc. de biol. **94**:631 (March 12) 1926.
28. Lyle, H. H. M.: Ann. Surg. **84**:288 (Aug.) 1926.
29. Dickson, F. D.: J. Missouri M. A., January, 1926, p. 1.

[Ed. Note.—We believe that the fusion operation has a place in the treatment of scoliosis, especially in paralytic scoliosis. It should be performed only after the maximum correction has been obtained by nonoperative treatment. In paralytic cases, because of the usually poor condition of the patient and the extent of the fusion, the operation is severe. We believe that the only way to avoid disaster in such cases is by thorough preoperative preparation, keeping the patient recumbent and filling him up with fluids and carbohydrates. In addition, the patient's blood should be typed for transfusion, and a donor should be instantly available.]

Fascial Reinforcement of Relaxed Joints.—Discussing relaxation of the knee joint, Bennett [30] says that there is a type of relaxation that allows normal function for the ordinary pursuits of civil life, but which does not permit the owner to participate in active athletics and sports. A stretched or attenuated anterior crucial permits outward rotation of the tibia and an increase in abduction of the tibia when the leg is in a semiflexed position. This explains the "semilocking" or "slipping out" which the patient complains of on turning with the leg semiflexed and the thigh adducted. The author has operated on eight such patients and reports the end results in six. Successful results were obtained in five, and one operation was a failure. The operation consisted of an incision parallel to the patella and patella tendon and opening into the joint. Plication of the capsule was done with fascial suture, and this was reinforced by the insertion of fascial strips along the medial border. The after treatment consisted of fixation in plaster for from four to six weeks, followed by exercises to restore mobility of the joint. The only case in which a satisfactory result was not obtained was also the only case in which the internal semilunar cartilage was removed. The author reports four patients having recurrent dislocation of the shoulder treated by sutures of fascia. The operation consists of plicating the anterior capsule of the shoulder with a fascial suture, and fixing it to the acromion by passing the suture through the acromion. A Velpeau bandage was applied for four weeks, followed by gradual use. The cases reported all showed satisfactory results.

Arthroplasty of the Hip.—Baer [31] has analyzed the end results of 100 cases of arthroplasty of the hip, in which his specially prepared animal membrane has been used as an interposing substance. He describes anew the technic of his operation, and states as his reasons for using the membrane that it is easily procured, is hole-proof, leaves no muscle hernias, shortens the time of operation, and, with the membrane

30. Bennett, G. E.: Fascia for Reenforcement of Relaxed Joints, Arch. Surg. **13**:655 (Nov.) 1926.

31. Baer, W. S.: J. Bone & Joint Surg. **8**:769 (Oct.) 1926.

now used, is not irritant. He points out that the limitation of motion after arthroplasty is usually due to shortening of the periarticular tissues. His statistics are as follows:

	Good results
19 cases of gonorrheal arthritis	95 per cent
27 cases of tuberculous arthritis	74 per cent
43 cases of septic infection	82 per cent
2 cases of fracture	100 per cent
9 cases of arthritis deformans	55 per cent

The figures for the entire group are 82 per cent good results. His criteria of a good result are: at least 25 per cent voluntary flexion, painless joint and stability in weight-bearing. In cases of gonorrheal arthritis, he advises waiting at least a year after the acute symptoms have subsided before doing an arthroplasty. In septic hips, two or three years should elapse. He believes that arthroplasty should not be done in children until full growth has been attained. He feels that the most successful results from arthroplasty are obtained in the jaw, and that next to this the hip yields the best results. The paper is accompanied by a complete bibliography.

[ED. NOTE.—We consider the report by Baer of the end-results of arthroplasty of the hip in a large group of cases one of the most complete and reliable that has been made. The paper was read at the meeting of the American Orthopaedic Association and was accompanied by a cinematic presentation of the cases before and after operation and of the roentgenograms which showed good and bad results impartially. Those of the editors who heard and saw the presentation believe that Baer proved that arthroplasty of the hip is a valuable procedure in properly selected cases. His criterion of a good result is not a high one, but the results as a whole, regardless of what standard is used, are unusually good.]

SYMPOSIUM ON ARTICULAR FRACTURES OF THE ITALIAN ORTHOPEDIC CONGRESS

At the recent Italian Congress of Orthopedic Surgeons, a conference was held on the subject of articular fractures. The conclusions which were arrived at by the congress are reported by Delitala and Marconi.[32] As these conclusions represent the most enlightened opinion of Italian surgeons on this difficult subject and are of importance not only in themselves, but also in comparison with the surgical thought of other countries, the editors are reporting them at more length than is usual in the Progress of Orthopedic Surgery.

---

32. Delitala, F., and Marconi, S.: I. Riforma med. **42**:45 (Nov. 8) 1927.

1. The Upper Extremity of the Humerus: Bloodless methods of reduction should always be used originally. Satisfactory results can usually be obtained. In incomplete fractures and in impacted fractures without displacement either of the anatomic or surgical neck, immobilization in abduction from ten to twenty days, followed by massage and movement, is the method of treatment. In fractures of either the anatomic or the surgical neck with displacement, immobilization in abduction with or without continuous traction is employed. In severe displacements, bloodless reduction under ether sometimes allows replacement of markedly displaced fragments. In Delitala's clinic, a plaster of Paris apparatus is always used, whether or not traction is employed. Immobilization does not usually exceed thirty days. Open reduction with or without osteosynthesis is reserved solely for cases of severe displacement which are irreducible or which are complicated by vascular or nerve disturbances. In recent fracture-dislocations, bloodless treatment is always attempted first. If this fails, open reduction is performed without removal of the head. Removal of the head is justified only if the fragment is very small or much comminuted. Removal of the dislocated head is, on the other hand, indicated in old fracture-dislocations. In obstetrical fractures it is well to use the hyperabduction method advocated by Whitman.

2. Fractures of the Elbow: In fractures of the elbow, excellent results are to be obtained by bloodless methods. After reduction of the fracture, which is obtained (except in supracondylar fractures due to flexion) almost always by a combination of traction and flexion of the forearm associated with direct manipulation of the fracture, the elbow should be immobilized in flexion at a right angle or in acute flexion with the forearm supinated. Immobilization may be obtained by posterior plaster splints or with circular apparatus, not too tight. Lateral deviations toward varus or valgus may be better corrected with plaster of Paris apparatus. Open reduction should be reserved for supracondylar fractures with marked displacement which cannot be reduced bloodlessly. Open treatment is the method of choice in comminuted fractures with marked displacement. In fractures of the condyles and epicondyles, it is not desirable to do an open operation, as it has been demonstrated that satisfactory results are not obtained, even though the anatomic reposition is perfect.

3. Fractures of the Wrist: Bloodless treatment almost invariably gives satisfactory results. Reduction is done under an anesthetic. Immobilization is usually in a position of palmar and ulnar flexion. The duration of immobilization should be from fifteen to twenty days.

4. Fractures of the Upper Extremity of the Femur: The fractures are usually through the neck or intertrochanteric region. Fractures of

the head, epiphyseal displacements, and subtrochanteric fractures represent only a small part. Fractures of the neck especially are characterized by their slow consolidation. According to the studies in Delitala's clinic, consolidation occurs in proportion as the fracture line approaches the base of the trochanters. Of various methods of treatment, three are in greatest use: the original method of Whitman, the method adopted by Rossi (reduction, immobilization and continuous traction) and a method modified from that of Whitman. The last method is the one used in Delitala's clinic. It consists of reduction, usually under a general anesthetic, and of manipulation in flexion, internal rotation, and mechanical traction, followed by fixation in a plaster of Paris spica which reaches below to the toes. The limb is held in moderate abduction (so that walking may be possible) and in internal rotation. If impaction is present, breaking up of the impaction is done only if there is evidence of good osteogenetic powers on the part of the patient. In fractures of the middle of the neck and of the neck close to the head, open treatment is used at once, unless there is some contraindication in the general condition. The exposure is made through an anterior incision. The osteosynthesis is obtained by a long Lambotte screw or an autogenous bone transplant from the tibia or from the fibula.

5. Fractures of the Lower Extremity of the Femur: Only a small percentage of all fractures is represented in those of the lower extremity of the femur. In adults with recent supracondylar or intracondylar fractures with moderate displacement, continuous traction is applied for about fifteen days with the knee flexed. This usually improves the position of the fragments. The position of flexion is of great importance in this fracture. Flexion is maintained with plaster of Paris splints forming a double inclined plane, with pillows placed beneath the popliteal space, or with apparatus of the type of Zuppinger. Traction is made in the line of the axis of the thigh. Subsequently, a plaster of Paris apparatus is applied with the knee in flexion. In supracondylar fractures with marked displacement, direct skeletal traction is used. In intracondylar fractures with marked displacement, osteosynthesis of the fracture with exact anatomic reconstruction must be used whenever bloodless methods do not give the desired reduction.

6. Fractures of the Upper Extremity of the Tibia: Practically the same methods are used in fractures of the upper extremity of the tibia as in fractures of the lower extremity of the femur—that is, continuous extension in flexion, and usually immobilization. Frequently, a hemarthrosis which should be aspirated is present. When the displacement of the fragments cannot be reduced bloodlessly, open operation is indicated.

7. Fractures of the Patella: Open reduction is the treatment of choice.

8. Fractures of the Ankle: The most frequent displacements that must be overcome in the treatment of a fracture of the ankle are the valgus position of the foot, the posterior subluxation of the foot, a certain amount of equinus deformity, and separation of the tibia and fibula. Bloodless methods are those chiefly used. It should be remembered that an exact anatomic reduction is necessary for a good functional result. In fractures involving only the internal and external malleolus, a posterior plaster of Paris shell is usually sufficient except in cases in which there is a rupture of the tibiofibular ligaments, when a small amount of varus position is required. The position of varus of the foot is the one of choice for immobilization of bimalleolar fractures and the fracture of Dupuytren. If posterior displacement of the foot combined with a fracture of the posterior margin of the tibia is present, the displacement is overcome by a movement of propulsion forward of the foot. The equinus position of the foot due to the contracture of the muscles of the calf is easily overcome when the reduction of the fracture is performed early. When delayed even one or two days, the movement of dorsiflexion frequently causes a redisplacement of the fragments. Therefore, it is opportune to overcome the equinus deformity in successive stages. Open reduction of fractures of the ankle should be limited to irreducible fractures or fractures that cannot be held in position.

[Ed. Note.—The editors find themselves in essential agreement with these conclusions.]

Motor Backfire Fractures of the Wrist.—Pointing out the wide diversity of opinion in respect to the exact nature of backfire fracture, Edwards [33] reported his own conclusions based on a study of forty-two patients treated at the King's College Hospital. He divides the cases according to the mechanism of the injury as follows:

1. Direct Violence: When the handle of the starting crank of the motor is wrenched from the hand and strikes the forearm. Here the fracture may occur at any point below the middle of the forearm. The most common site is about 1 inch above the articular margin. The displacement is usually slight.

2. Indirect Violence: When the handle kicks back, with the hand on it. Here there may be two different mechanisms: (*a*) With the thumb in front and the wrist in abduction. This usually results in a fracture of the styloid. (*b*) When the thumb is placed behind the handle, in line with the fingers. Here the mechanism is one of pure hyperextension, and the radius fractures at its weakest point, which is between 2½ and 3 inches above the joint. Edwards describes the treat-

33. Edwards, H. C.: J. Bone & Joint Surg. **8**:701 (Oct.) 1926.

ment he employs, which conforms to the usual methods of closed reduction and splinting. Operation is advocated only in cases of long standing, when a wedged or curved osteotomy is advised. In fracture through the epiphysis, he recommends fixation for at least three weeks after reduction before massage and motion are begun.

Fractures of the Os Calcis.—Harding [34] describes the treatment he employs in "smash" fractures of the os calcis with broadening. With the knee flexed over the end of a table, reduction is accomplished by the following means: A claw retractor is embedded in the skin at the back of the heel and a stool with a triangular wedge of wood on it is placed under the foot and is screwed up so that the arch of the foot is forced upward, the forefoot being held down with the hand, and downward traction exerted on the heel by means of the retractor. A cabinet maker's D clamp is then applied to the sides of the heel to correct the broadening. A plaster cast from toes to mid thigh is then applied with the knee semiflexed and the foot in equinus. This is worn three weeks. Full weight-bearing is permitted at the end of three months. The author reports that of fifteen patients treated in this manner (two of the cases were bilateral), all are at work, the average duration of disability being five months.

[ED. NOTE.—This method of reduction appears dangerous on account of the trauma it inflicts on an already extensively traumatized area. The results, however, are described as good. The fact that all the patients are reported as back at work at the end of five months makes us wonder whether it is meant by this that they are back at their old jobs and earning the same wage as previously.]

Ankylosis in One Thousand One Hundred and Fourteen Cases of Fracture.—It has been claimed by those who oppose open intervention in the treatment of fractures that nonunion follows this method of treatment more frequently than it does closed methods. Those who hold this view may find support for their contention in the statistics of Newell,[35] who has analyzed 1,114 cases of fracture, epiphyseal separation and dislocation. Only 5 per cent, or fifty-five patients, were treated by open operation, only twenty-three of these being for injuries not compound. The author states that not a single case of nonunion resulted in the entire group. Reduction was accomplished with the aid of the fluoroscope in almost all the cases. The largest group of fractures was of the phalanges, numbering 224 cases, and the next largest was of the radius, numbering 103 cases.

Fracture Experience in the Norton Company.—The newly opened fields of study in industrial medicine have put stress on the commercial

34. Harding, M. C.: J. Bone & Joint Surg. **8**:720 (Oct.) 1926.
35. Newell, E. T.: South. M. J. **19**:688 (Sept.) 1926.

value of the workman's time. In the case of fractures, data must be accumulated from which estimates may be made of what represents the normal period of disability of different types of injury. Clark's study [36] of 127 fractures in a manufacturing plant of 2,600 employees is of value principally in comparison with other tabulations that are made. In a factory in which it was possible to take back the employees at the earliest possible moment by providing work of a type especially adapted to their injuries, the average time lost was thirty-eight days. This showing appears satisfactory, but the article carries the suggestion that it ought to be possible to shorten the period further.

The Operative Treatment of Fractures.—Soudder [37] feels that closed methods in the treatment of fractures have been perfected to the point that further development along this line cannot be expected. If further improvement in treatment is to occur, it will result only from refinement and development of the operative method of treatment. Technical improvements in the future will lessen the risk of operation just as they have already in the past. Even now the ever widening expansion of operative treatment is being witnessed. Soudder feels that already it is possible to say, in respect to certain fractures, that operative treatment is the method of choice. He proceeds to summarize the advantages of operative treatment in general and to indicate in as much detail as possible the conditions in which he considers operative treatment necessary. It is not possible to summarize these, and they should be read in the original article.

RESEARCH

Comparative Studies of Synovial Fluid and Plasma.—From a comparative study of the synovial fluid and the blood plasma in twenty-three cases of articular lesions of known pathologic changes, Allison, Fremont-Smith, and Kennard [38] have determined the relation between the protein, chloride, sugar and nonprotein nitrogen content of the two fluids. The protein contents of the fluids is less than that of the plasma, and the chloride content is greater in the fluid. This is the same relationship that holds in pleural fluid, peritoneal fluid and in cerebrospinal fluid. The sugar content in noninfected fluids from fasting patients is slightly lowered, while in bacterially infected fluids the sugar is markedly lowered. In two cases of tuberculous disease of the joints, the sugar content was moderately lowered. The authors suggest that the determination of the sugar content may be of considerable diagnostic value.

---

36. Clark, W. I.: Boston M. & S. J. **195**:1064 (Dec. 2) 1926.

37. Soudder, C. L.: Boston M. & S. J. **195**:1187 (Dec. 28) 1926.

38. Allison, Nathaniel; Fremont-Smith, Frank; Dailey, Mary Elizabeth, and Kennard, Margaret: J. Bone & Joint Surg. **8**:758 (Oct.) 1926.

Ischemic Contracture.—Jepson [39] has made a comprehensive review of the literature on "ischemic" paralysis and reports the results of animal experiments to reproduce this lesion. By ligation of the femoral vein combined with incision across the middle third of the thigh and the use of a constricting bandage, he was able to produce the condition in dogs. However, when the incision was drained the lesion did not develop. He discusses the pathologic changes observed in man and points out that the condition may develop with or without the use of bandages, splints, etc. That the tension due to extravasated blood and serum is an important factor seems clear, and he suggests that early drainage may be of value.

[ED. NOTE.—Jepson's observations confirm the conclusions of Brooks that venous obstruction is the important causative factor. The latter produced the lesion in the isolated muscles of dogs, while the former has produced it in the entire limb.]

Growth of Long Bones in Childhood.—Harris [40] has made a study of the growth of the long bones. He has observed the rate of growth in a child of 106 weeks, in whom the growth began at the age of 32 months. He states that his observations confirm the experiments of Hunter and Duchamel and clearly show that there is no intercalated growth—that is, growth from the center, in the diaphysis of the long bones. Transverse striations are shown to be manifestations of cessation of growth. These occur normally in adolescence. They may occur with seasonal variations in the rate of growth or in cases in which there is marked arrest in the rate of growth due to acute illness or starvation. They occur in rickets as part of the healing process. There are three processes normally concerned in the formation of new bone—cartilage proliferation, cartilage calcification and degeneration, and ossification proper. These three processes are related to (1) a water soluble, growth-promoting vitamin or vitamins; (2) the enzyme of Robinson or vitamin X, and (3) the fat soluble vitamin or vitamin A. The author states that the term "growth-promoting," which is commonly used in connection with vitamin A, is a misnomer, since the true growth-promoting vitamins are water soluble. He also believes that any conclusions concerning methods of curing rickets which are based on the "line test" are fallacious, as cessation of growth is the factor that determines this.

Read

Brittle Bones and Blue Sclera.—Key [41] has observed a case of brittle bones and blue sclera and has made a study of the bone material obtained by operation. From this he concludes that the underlying process is an

39. Jepson, P. N.: Ann. Surg. **84**:785 (Dec.) 1926.

40. Harris, H. A.: Growth of Long Bones in Childhood, Arch. Int. Med. **38**: 785 (Dec.) 1926.

41. Key, J. A.: Brittle Bones and Blue Sclera, Arch. Surg. **13**:523 (Oct.) 1926.

"hereditary hypoplasia of the mesenchyme," which name he applied to the whole syndrome. He emphasizes the fact that the condition is hereditary and gives in detail a review of the literature on this question. In contrast to osteogenesis imperfecta, the fractures in this condition are not numerous and do not appear at birth. Deformities are common, due to malunion of the fractures, and there is an unusual laxity of the joint structures. The bones show marked brittleness. The laminae are irregular in arrangement, and the amount of compact bone is decreased by the presence of numerous large canals. This probably accounts for the frequency of fractures. The author feels that the condition described does not resemble osteogenesis imperfecta, the latter not being hereditary. From idiopathic osteopsathyrosis, the differentiation is not so clear. Here heredity again distinguishes the condition. He offers the following classification of idiopathic bone fragility:

1. Hereditary form—hereditary hypoplasia of the mesenchyme.
2. Nonhereditary forms.
   a. Osteogenesis imperfecta.
   b. Osteopsathyrosis with white sclerae.
   c. Osteopsathyrosis with blue sclerae.
3. Probably not hereditary—osteosclerosis fragilis generalisata or marble bones.